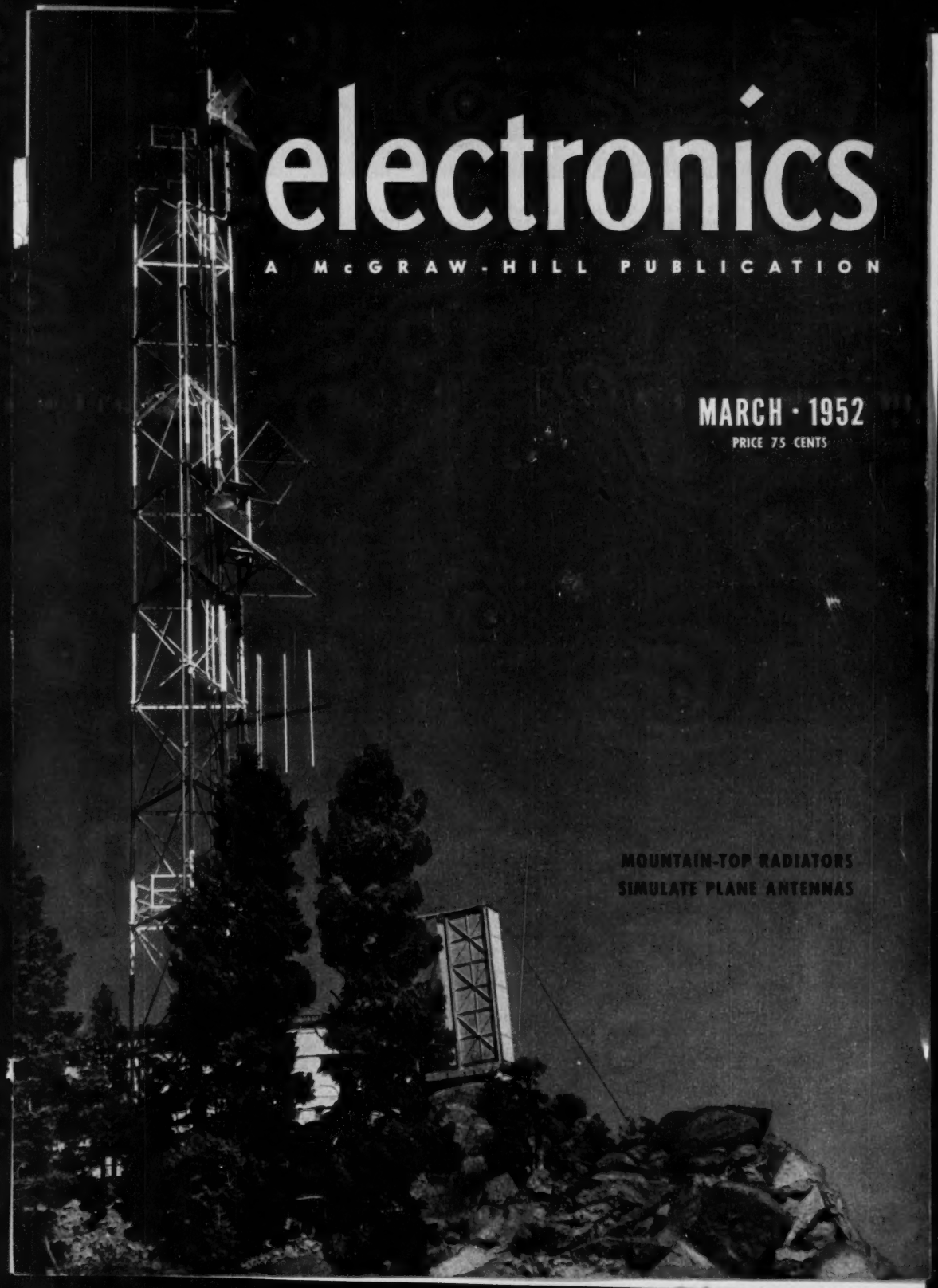
electronics

A McGRAW-HILL PUBLICATION

MARCH · 1952

PRICE 75 CENTS



MOUNTAIN-TOP RADIATORS
SIMULATE PLANE ANTENNAS

ULTRA COMPACT UNITS...OUNCER UNITS

HIGH FIDELITY . . . . SMALL SIZE . . . . FROM STOCK

UTC Ultra compact audio units are small and light in weight, ideally suited to remote amplifier and similar compact equipment. High fidelity is obtainable in all individual units, the frequency response being ± 2 DB from 30 to 20,000 cycles.

True hum balancing coil structure combined with a high conductivity die cast outer case, effects good inductive shielding.

Type No.	Application	Primary Impedance	Secondary Impedance	List Price
A-10	Low impedance mike, pickup, or multiple line to grid	50, 125/150, 200/250, 333, 500/600 ohms	50 ohms	$16.00
A-11	Low impedance mike, pickup, or line to 1 or 2 grids (multiple alloy shields for low hum pickup)	50, 200, 500	50,000 ohms	18.00
A-12	Low impedance mike, pickup, or multiple line to grids	50, 125/150, 200/250, 333, 500/600 ohms	80,000 ohms overall, in two sections	16.00
A-14	Dynamic microphone to one or two grids	30 ohms	50,000 ohms overall, in two sections	17.00
A-20	Mixing, mike, pickup, or multiple line to line	50, 125/150, 200/250, 333, 500/600 ohms	50, 125/150, 200/250, 333, 500/600 ohms	16.00
A-21	mixing, low impedance mike, pickup, or line to line (multiple alloy shields for low hum pickup)	50, 200/250, 500/600	50, 200/250, 500/600	18.00
A-16	Single plate to single grid	15,000 ohms	60,000 ohms, 2:1 ratio	15.00
A-17	Single plate to single grid 8 MA unbalanced D.C.	As above	As above	17.00
A-18	Single plate to two grids. Split primary	15,000 ohms	80,000 ohms overall, 2.3:1 turn ratio	16.00
A-19	Single plate to two grids 8 MA unbalanced D.C.	15,000 ohms	80,000 ohms overall, 2.3:1 turn ratio	19.00
A-24	Single plate to multiple line	15,000 ohms	50, 125/150, 200/250, 333, 500/600 ohms	16.00
A-25	Single plate to multiple line 8 MA unbalanced D.C.	15,000 ohms	50, 125/150, 200/250, 333, 500/600 ohms	17.00
A-26	Push pull low level plates to multiple line	30,000 ohms plate to plate	50, 125/150, 200/250, 333, 500/600 ohms	16.00
A-27	Crystal microphone to multiple line	100,000 ohms	50, 125/150, 200/250, 333, 500/600 ohms	16.00
A-30	Audio choke, 250 henrys @ 5 MA 6000 ohms D.C., 65 henrys @ 10 MA 1500 ohms D.C.			12.00
A-32	Filter choke 60 henrys @ 15 MA 2000 ohms D.C., 15 henrys @ 30 MA 500 ohms D.C.			10.00

TYPE A CASE
1½" x 1½" x 2" high

UTC OUNCER components represent the acme in compact quality transformers. These units, which weigh one ounce, are fully impregnated and sealed in a drawn aluminum housing ⅞" diameter... mounting opposite terminal board. High fidelity characteristics are provided, uniform from 40 to 15,000 cycles, except for O-14, O-15, and units carrying DC which are intended for voice frequencies from 150 to 4,000 cycles. Maximum level 0 DB.

OUNCER CASE
⅞" Dia. x 1⅛" high

Type No.	Application	Pri. Imp.	Sec. Imp.	List Price
O-1	Mike, pickup or line to 1 grid	50, 200/250 500/600	50,000	$14.00
O-2	Mike, pickup or line to 2 grids	50, 200/250 500/600	50,000	14.00
O-3	Dynamic mike to 1 grid	7.5/30	50,000	13.00
O-4	Single plate to 1 grid	15,000	60,000	11.00
O-5	Plate to grid, D.C. in Pri.	15,000	60,000	11.00
O-6	Single plate to 2 grids	15,000	95,000	13.00
O-7	Plate to 2 grids, D.C. in Pri.	15,000	95,000	13.00
O-8	Single plate to line	15,000	50, 200/250, 500/600	14.00
O-9	Plate to line, D.C. in Pri.	15,000	50, 200/250, 500/600	14.00
O-10	Push pull plates to line	30,000 ohms plate to plate	50, 200/250, 500/600	14.00
O-11	Crystal mike to line	50,000	50, 200/250, 500/600	14.00
O-12	Mixing and matching	50, 200/250	50, 200/250, 500/600	13.00
O-13	Reactor, 300 Hys.—no D.C.; 50 Hys.—3 MA. D.C.,		6000 ohms	10.00
O-14	50:1 mike or line to grid	200	½ megohm	14.00
O-15	10:1 single plate to grid	15,000	1 megohm	14.00

150 VARICK STREET • NEW YORK 13, N. Y.
EXPORT DIVISION 13 EAST 40th STREET, NEW YORK 16, N. Y. CABLES "ARLAB"

electronics

MARCH • 1952
A McGRAW-HILL PUBLICATION

MOUNTAIN-TOP RADIATORS SIMULATE PLANE ANTENNAS ..... COVER
Propagation studies, important to air navigation, communications, f-m and tv, by National Bureau of Standards in 100 to 1,000-mc range show greater distant-signal level than previously thought possible (see p 156)

FIGURES OF THE MONTH 4
Includes Electronics Output Index, a barometer for management

INDUSTRY REPORT 5
Top-level news, trends and market interpretations

HOW TO DEVELOP A NEW PRODUCT, by Oscar E. Carlson 98
Complete picture of the proper method for designing and marketing a new electronic product

SIMULTANEOUS A-M AND F-M IN ROCKET TELEMETERING, by W. Cullen Moore 102
A five-megacycle video signal rides the same carrier as a wide-band experimental impulse

EVAPORATION-COOLED POWER TUBES, by Charles Beurtheret 106
More efficient transfer of heat increases tube ratings, provides distilled water and warms building

F-M SUBMINIATURE TRANSMITTER-RECEIVER, by Edward Kasner 108
Complete description of latest model Signal Corps f-m portable station

NEW INDUSTRIAL MOTOR CONTROL CIRCUITS, by E. F. Kubler 110
Stage-by-stage analysis of newest 16-tube variable-speed electronic drive for industrial d-c motors

STABILIZING VERTICAL DEFLECTION AMPLIFIERS, by W. B. Whalley, C. Masucci and K. Hillman 116
Addition of simple inverse feedback network greatly improves performance

ELECTRON TUBE CURVE GENERATOR, by M. L. Kuder 118
Oscillograms of receiving-tube static characteristic curves are produced automatically in a minute

TEN YEARS OF PROGRESS IN MOBILE F-M RECEIVERS, by A. G. Manke and R. T. Myers 125
Shows one manufacturer's methods for improving selectivity without increasing size or number of tubes

MEASURING UHF-TV RECEIVER NOISE FIGURES, by S. R. Scheiner and G. W. Carter 128
Improved technique offers increased range with less complexity

40-DB FEEDBACK AUDIO AMPLIFIER, by Benjamin B. Driske and R. D. Darrell 130
Dual-channel system eliminates L-C crossover filter to give effectively zero output impedance

CIRCUIT STABILITY IN GUIDED MISSILES, by R. L. Kelly 133
Design of military circuits for dependability of tube operation

ONE MICROVOLT SHOWS FULL SCALE, by H. C. Thomas and C. W. Hewlett, Jr 136
Signal amplitudes of less than one microvolt are measured accurately with system using special shielded transformer

FERRITE APPLICATIONS IN ELECTRONIC COMPONENTS, by B. V. Vonderschmitt, M. J. Obert, H. B. Stott .. 138
Two current uses of ferromagnetic spinels in radio and tv receivers

TELEVISION PICTURE LINE SELECTOR, by Joseph Fisher 140
Video waveform of a single scanning line is identified and analyzed on screen of cro

ANTENNA GAIN BY GRAPHICAL MEANS, by M. W. Scheldorf 144
Radiation patterns plotted on special graph paper allow simple determination of antenna gain

KLYSTRON CIRCUITS (Reference Sheet), by A. E. Harrison 148
Three regulated power supply circuits, three oscillator circuits and phase modulator for modern klystrons

CROSSTALK.....97 ELECTRONS AT WORK.....152 PRODUCTION TECHNIQUES.....244 NEW PRODUCTS.....314
NEWS FROM THE FIELD.....382 NEW BOOKS.....400 BACKTALK.....418 INDEX TO ADVERTISERS (Last Page)

DONALD G. FINK, *Editor*; **W. W. MacDONALD**, *Managing Editor*; John Markus, Vin Zeluff, A. A. McKenzie, James D. Fahnestock, *Associate Editors*; William P. O'Brien, Ronald K. Jurgen, *Assistant Editors*; Fred Goldberg, *News Editor*; John M. Carroll (on Military leave), Ann Mastropolo, M. Wood, *Editorial Assistants*; Gladys T. Montgomery, *Washington Editor*; Harry Phillips, *Art Director*; E. Luke, *Art Assistant*

KEITH HENNEY, *Consulting Editor*

H. W. MATEER, *Publisher*; **WALLACE B. BLOOD**, *Manager*; R. S. Quint, *Buyers' Guide Manager*; N. F. Cullinan, *Promotion & Research Assistant*; H. E. Hilty, *Classified Manager*; D. H. Miller, James Girdwood, *New York*; Wm. S. Hodgkinson, *New England*; Warren W. Shew, *Philadelphia*; C. D. Wardner, *Chicago*; J. L. Phillips, *Cleveland*; T. H. Carmody, R. C. Alcorn, *San Francisco*; Carl W. Dysinger, *Los Angeles*; Ralph C. Maultsby, *Atlanta*

March, 1952 ELECTRONICS Vol. 25, No. 3

Member ABC and ABP

Published monthly with an additional issue in June by McGraw-Hill Publishing Company, Inc., James H. McGraw (1860-1948), Founder. Publication Office, 99-129 North Broadway, Albany 1, N. Y.

Executive, Editorial and Advertising Offices: McGraw-Hill Building, 330 W. 42nd St., New York 36, N. Y. Curtis W. McGraw, President; Willard Chevalier, Executive Vice-President; Joseph A. Gerardi, Vice-President and Treasurer; John J. Cooke, Secretary; Paul Montgomery, Senior Vice-President, Publications Division; Ralph B. Smith, Editorial Director; Nelson Bond Vice-President and Director of Advertising; J. E. Blackburn, Jr., Vice-President and Director of Circulation.

Subscriptions: Address correspondence to Electronics—Subscription service, 99-129 N. Broadway, Albany 1, N. Y., or 330 W. 42nd St., New York 36, N. Y. Allow ten days for change of address. Please indicate position and company connection on all subscription orders.

Single copies 75¢ for United States and possessions, and Canada; $1.50 for Latin America; $2.00 for all other foreign countries. Buyers' Guide $2.00. Subscription rates—United States and possessions, $6.00 a year; $9.00 for two years. Canada, $10.00 a year; $16.00 for two years. Pan American countries, $15.00 a year; $25.00 for two years. All other countries $20.00 a year; $30.00 for two years. Entered as second class matter August 29, 1928, at the Post Office at Albany, N. Y., under act of Mar. 3, 1879. Printed in U. S. A.

Copyright 1952 by McGraw-Hill Publishing Co., Inc.—All Rights Reserved.

BRANCH OFFICES: 520 North Michigan Avenue, Chicago 11, Ill.; 68 Post Street, San Francisco 4; Aldwych House, Aldwych, London, WC. 2; Washington, D. C., 4; Philadelphia 3; Cleveland 15; Detroit 26; St. Louis 8; Boston 16; Atlanta 3, Ga.; 1111 Wilshire Blvd., Los Angeles 17; 738-9 Oliver Building, Pittsburgh 22. ELECTRONICS is indexed regularly in The Engineering Index.

NEW

marion "tamper-proof"
hermetically sealed running time meter

REGISTERS OPERATING TIME OF MACHINE TOOLS, ELECTRONIC, ELECTRICAL OR GENERAL INDUSTRIAL EQUIPMENT

SPECIFICATIONS

- Registers in 1/10 hour steps to 9999.9 or hour steps to 99999
- Hermetically sealed, glass to metal
- Moisture-proof, dust-proof
- Drawn steel case provides magnetic shielding
- Self-starting synchronous motor
- Moderately priced

Marion's new Running Time Meter is absolutely tamper-proof because it is sealed in a drawn steel case. Designed for a wide range of operating temperatures, it is also ideal for use in hazardous atmospheres. The easy-to-read dial is viewed through tempered glass crystal which is fused directly to the case.

Powered by a durable self-starting synchronous motor, available for 110-125, 220-250 volts . . . 50 or 60 cycle A. C. . . . the Marion Running Time Meter occupies no more panel space than an ordinary 3½" meter.

Demands of our national mobilization program come first, of course, but we will gladly supply further information and serve you to the best of our ability.

MARION ELECTRICAL INSTRUMENT CO., 401 CANAL ST., MANCHESTER, N. H.

marion meters

MANUFACTURERS OF MARION Ruggedized PANEL METERS

THIS INFORMATIVE QUARTERLY WILL BE MAILED TO YOUR ADDRESS WITHOUT CHARGE

FILL IN THIS COUPON NOW

MUIRHEAD & CO. LTD · BECKENHAM · KENT · ENGLAND

Please mail me, free of charge, your quarterly journal "TECHNIQUE"

NAME_____

POSITION_____

COMPANY_____

ADDRESS_____

_____

_____

MUIRHEAD & Co. LTD.

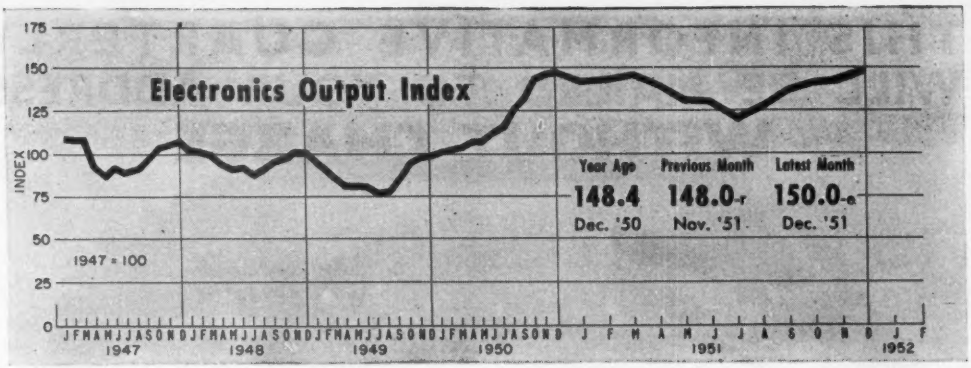
PRECISION ELECTRICAL INSTRUMENT MAKERS

BECKENHAM · KENT · ENGLAND

Telegrams and Cables: MUIRHEADS ELMERS-END

PRECISION MUIRHEAD ELECTRICAL INSTRUMENTS

MU.29



FIGURES OF THE MONTH

RECEIVER PRODUCTION

(Source: RTMA)

	Year Ago	Previous Month	Latest Month
	Dec '50	Nov '51	Dec '51
Television sets	858,500	415,332	453,098-p
Home Radio sets	957,100	477,734	555,133-p
Portable sets	95,000	64,111	75,799-p
Auto sets	453,500	206,069	213,492-p

RECEIVER SALES

(Source: Licensee figures)

	Nov '50	Oct '51	Nov '51
Television sets, units	659,758	608,274	559,923
Electric radio sets, units	562,979	540,915	519,888
Battery sets, units	70,143	65,703	69,599
Auto sets, units	469,218	265,215	238,275
Television sets, value	$131,759,339	$96,111,904	$95,055,472
Electric radio sets, value	$15,564,952	$11,517,531	$11,287,914
Battery sets, value	$1,249,214	$1,176,656	$1,320,649
Auto sets, value	$11,942,960	$8,088,701	$7,340,214

RECEIVING TUBE SALES

(Source: RTMA)

	Nov '50	Oct '51	Nov '51
Receiv. tubes, total units	39,326,641	34,137,519	32,710,369
Receiving tubes, new sets	31,327,152	21,103,669	20,405,712
Rec. tubes, replacement	6,744,892	9,615,159	8,539,275
Receiving tubes gov't	119,600	1,567,190	1,371,886
Receiving tubes, export	1,134,997	1,851,501	2,393,496
Picture tubes, to mfrs.	851,872	455,636	460,566

BROADCAST STATIONS

(Source: FCC)

	Jan '51	Dec '51	Jan '52
TV Stations on Air	107	108	108
TV Stns CPs—not on air	2	0	0
TV Stns—Applications	379	475	488
AM Stations on Air	2232	2331-r	2331
AM Stns CPs—not on air	121	77	75
AM Stns—Applications	271	304	311
FM Stations on Air	669	637-r	635
FM Stns CPs—not on air	21	13	13
FM Stns—Applications	11	8	7

NETWORK BILLINGS

(Source: Pub. Info. Bureau)

	Dec '50	Nov '51	Dec '51
AM/FM—ABC	$2,898,508	$3,220,760	$3,300,219
AM/FM—CBS	$6,544,490	$5,257,454	$5,278,508
AM/FM—MBS	$1,312,393	$1,583,291	$1,697,014
AM/FM—NBC	$5,077,740	$4,315,646	$4,343,307
TV—ABC	$1,298,616	$1,911,243	$1,980,145
TV—CBS	$2,304,602	$4,605,506	$4,736,368
TV—Dumont	Not avail.	$847,373	$937,875
TV—NBC	$3,274,757	$6,535,907-r	$6,592,673

p—provisional; r—revised; e—estimated

TV AUDIENCE

(Source: NBC Research Dept.)

	Jan '51	Dec '51	Jan '52
Sets in Use—total	10,549,500	15,176,200	15,777,000
Sets in Use—netw'k conn.	8,946,100	14,363,700	14,931,100
Sets in Use—New York	2,050,000	2,720,000	2,800,000
Sets in Use—Los Angeles	801,000	1,065,000	1,090,000
Sets in Use—Chicago	830,000	1,060,000	1,090,000

COMMUNICATION AUTHORIZATIONS

(Source: FCC)

	Dec '50	Nov '51	Dec '51
Aeronautical	29,048	31,415	30,370
Marine	28,237	33,700	33,914
Police, fire, etc.	8,400	9,969	10,161
Industrial	7,841	11,233	11,449
Land Transportation	4,060	5,362	4,653
Amateur	90,599	99,292	100,922
Citizens Radio	412	674	749
Disaster	0	28	26
Experimental	484	452	452
Common carrier	834	835	835

EMPLOYMENT AND PAYROLLS

(Source: Bur. Labor Statistics)

	Nov '50	Oct '51	Nov '51
Prod. workers, electronic	278,400	257,200-r	266,200-p
Prod. wkrs., radio, etc.	192,000	159,400-r	165,900-p
Av. wkly. earnings, elect.	$58.83	$63.38-r	$64.23-p
Av. wkly. earnings, radio	$56.32	$60.39	$60.96-p
Av. weekly hours, elect.	41.2	41.1	41.6-p
Av. weekly hours, radio	40.9	41.0	41.5-p

STOCK PRICE AVERAGES

(Source: Standard and Poor's)

	Jan '51	Dec '51	Jan '52
Radio—TV & Electronics	211.2	265.6	270.9
Radio Broadcasters	193.3	252.6	261.4

INDUSTRIAL EQUIPMENT ORDERS

(Source: NEMA)

	Quarterly Figures		
	Year Ago	Previous Quarter	Latest Quarter
	3rd '50	2nd '51	3rd '51
Dielectric Heating	$300,000	$600,000	$210,000
Induction Heating	$1,100,000	$2,300,000	$1,900,000

INDUSTRIAL TUBE SALES

(Source: NEMA)

	3rd '50	2nd '51	3rd '51
Vacuum (non-receiving)	$3,370,000	$7,750,000	$8,420,000
Gas or vapor	$1,660,000	$2,700,000	$2,620,000
Phototubes	$230,000	$360,000	$275,000
Magnetrons and velocity modulation tubes	$2,050,000	$4,130,000	$3,750,000

INDUSTRY REPORT

Defense Department Stretches Out Production

Some arms orders cut back for 1952, but not electronics

STRETCHING out rather than peaking of the mobilization program, now planned by Washington, will apply to the production of electronic equipment as well as other items made for the armed forces. There'll be, however, more stretching out than slowing down of actual production in our specific field.

Reshuffling of the mobilization program that has been going on is due largely to a shift in future plans. Instead of turning out weapons at an 'all-out' pace this year and next, defense and mobilization officials have decided to spread the program over a longer period . . . through all of 1954 and part of '55.

This means industry will produce such arms as airplanes, tanks, ships and guns a little more slowly—at about thirty percent below the rate expected late this year or early 1953.

▶**Little Change Seen**—Military and other mobilization officials predict that scaling back won't have much effect on overall electronic production. Electronic components and accessories for aircraft are only a fraction of the industry's total output for the armed services, say these officials. Such programs as guided missiles, modernization of all types of weapons and equipment will not be affected. They will go right ahead at present rates—or faster.

The experts say ordering of electronic equipment may level off somewhat this year, however. Military orders were going out at a rate of over $300 million a month at the first of the year, and were scheduled to continue upward through July. Now you can expect military awards of contracts to remain somewhere near present levels for the rest of this year.

▶**Civilians Gain**—Slowdown in military production eventually will mean more metal for makers of civilian items. Mobilization authorities think they now can promise that military requirements for materials are at a peak.

By the end of the year there probably will be more aluminum, as well as steel, for consumer goods. Key materials for electronics production—nickel and copper—will continue to be scarce, however, probably throughout this year and next.

CONTROLLED LIFEBOAT

Dropped by the Air Force, this lifeboat is unerringly guided by a radio signal from the plane and Westinghouse electronic controls to crash or shipwreck survivors

TV Expansion Considered Within Bounds of Present Material Allocations

RTMA report examines prospect for new stations and increased demand for receivers

THE TV INDUSTRY went a long way February 7th toward answering a big question mark in video's future: *Can the defreeze take place without running smack into serious shortages of materials?* On that date RTMA released a report on "The Impact of TV Expansion" which said, with minor qualifications, *"No big trouble anticipated"*.

This optimistic conclusion was reached by a four-man task force appointed by the Television Committee, headed by W. H. Chaffee of Philco, to look into the rate at which stations might be built, using scarce materials in the building, and thereafter take the air, creating new demand for receivers.

Handed a clouded crystal ball, the task group adopted three bases for the calculations ("optimistic, realistic and pessimistic"), hoping that at least one answer would stand the test of time.

▶**Transmitter Market**—First question was the rate at which FCC would authorize the construction of new stations. Most optimistic thinking was that the Commission might issue 70 construction permits per quarter, half to vhf and half to uhf, beginning with second quarter of 1952. That would make 490 new permits by the end of 1953. With 70 additional power amplifiers thrown in for power increases at existing stations, this adds up to a total of 560. The pessimists divided this total figure by nearly 3, for a total of 200. Most realistic estimate was that 280 permits for new stations and 50 for power increases would be

handed down by the end of 1953.

Second question, how long to get these stations on the air, was estimated "realistically" at 164 new stations and 30 power increases on the air by the end of 1953, leaving 116 new stations and 20 power increases "still building" at that time.

► **Equipment On Hand**—A survey of transmitting equipment on hand showed 28 vhf jobs already sold to prospective broadcasters, another 20 in stock, and materials on hand for another 149. No uhf transmitters are ready, but materials are available for five units. A detailed breakdown on the requirements for carbon, alloy and stainless steel, copper, brass and aluminum disclosed that the additional transmitting equipment could be readily built within existing allocations, even on the most optimistic estimate of new station construction.

Towers are not so easy. Under the "optimistic" schedule, taking a 400-foot steel tower as a basis, the 3rd and 4th quarter 1952 requirements would aggregate 5,775 tons of structural steel and 38.5 tons of copper. No prospect of these amounts is in sight. So, even on the realistic estimate, improvised towers will probably be necessary. But all anticipated stations can still get on the air within material limitations now in effect.

► **Receivers Market**—Estimate of new receiver demand, based on markets opened up and extensions of old markets, runs much smaller than previous industry findings.

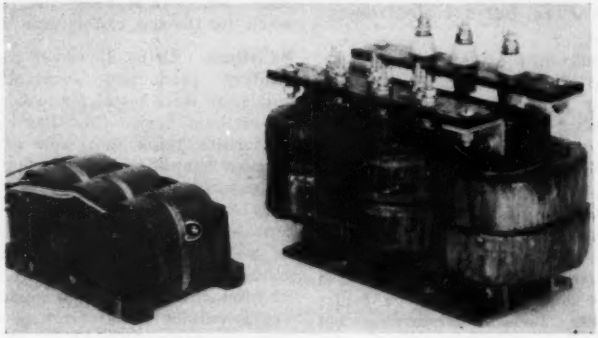
The optimists think that receiver demand in newly covered areas may run from 50,000 in the third quarter of 1952 to nearly 900,000 in the second quarter of 1953, making 1.6 million sets for the year over and above existing levels. The realistic estimate is about half this level, running from 23,000 to 434,000, or 810,000 for the year from mid-1952 to mid-1953. This figure is about one fifth the estimated tv receiver production for 1952. Consequently, new markets can readily be served by set manufacturers, if the present level of consumer demand in the established markets does not increase.

Fair Trade Rules Near Ready for FTC

ADVERTISING, promotion and other business rules coming under the general heading of 'Fair Trade Practice' for the radio-tv industry have been whipped into shape by the Radio and Television Manufacturers Association.

There are some 34 separate and distinct rules in the latest draft, awaiting final touches before presentation to the Federal Trade Commission.

LESS HEAT, LESS WEIGHT, LESS SPACE



Aircraft designers and operators got a lift from a report that Raytheon's Leonhard Katz has reduced overall weight of electronic gear to half normal. The trick is done by blowing turbulent air through ducts rather than over the outside of standard components. Typical reduction is exemplified by direct-cooled three-phase, 1,100-va transformer at left weighing 8 pounds, with a volume of 59 cu in. It is interchangeable with conventional model at right weighing 18 pounds and requiring 200 cu in.

Business Plans for New Plant and Equipment

Expansion this year will be greatest in history; it will continue even after the peak

AMERICAN INDUSTRY has huge plans for new plant and equipment. That's the main conclusion of a survey by McGraw-Hill to which ELECTRONICS contributed. From the mass of material gathered by our Department of Economics two things stand out:

The year ahead will set a record. *Companies plan to lay out 13 percent more for capital goods than ever before in history.*

After 1952, investment will still be big. *Although mobilization expansion may have passed its peak, business intends to keep spending at a level well above pre-Korea.*

This year will be the high-water mark in what has been the greatest all-time wave of expansion in the U. S. Industries whose capital expenditures are now rising most sharply are those with defense contracts or defense-supporting priorities.

► **Post-Peak Prospects**—Industry spending, adding up to $21.2 billion planned for 1952, may drop in 1953. But the idea that after mobilization capital will dry up, as it did in the 1940's, can now be written off.

All signs point to a total of $16.7 billion in capital expenditures in 1953, $15.1 billion in 1954, and $14.1 billion in 1955. The actual drop from 1952 to 1955 may amount to no more than 20 percent. That would still leave investment within 10 percent of 1951, and well above pre-Korea.

► **Electronics Up Front**—The 13-percent jump that will take capital

(Continued on page 8)

WHY THE EYES OF THE WORLD WERE ON THIS SHIP!

Last Hours of the Flying Enterprise

Sylvania Glow Modulator Tubes
help bring dramatic on-the-spot photos to your newspapers

Never in history had a disaster at sea been witnessed by so many people. Millions watched the battle of the Flying Enterprise . . . vividly shown, practically blow for blow, on front pages everywhere.

The pictures of this struggle were made possible by the Sylvania Glow Modulator Tube, which forms the heart of radiophoto and wirephoto receivers.

The unique ability of this tube to vary its light output intensity at a 15 kc rate also makes it valuable for oscillograph timing markers, seismograph recorders, and psychological-eye-response equipment.

For complete information about the Sylvania Glow Modulator Tube write Sylvania Electric Products Inc., Department E-2603, Emporium, Pennsylvania.

Here's How the Glow Modulator Helps Bring You the Pictures

Pictures were taken from airplanes and flown to England. Here they were scanned by a facsimile transmitter which translated the tiny black and white picture elements into a series of electronic impulses which were sent over the Atlantic. At receiving stations Sylvania Glow Modulator Tubes responded to these impulses and "painted" on sensitized paper a faithful reproduction of the original.

SYLVANIA

RADIO TUBES; TELEVISION PICTURE TUBES; ELECTRONIC PRODUCTS; ELECTRONIC TEST EQUIPMENT; FLUORESCENT TUBES, FIXTURES, SIGN TUBING, WIRING DEVICES; LIGHT BULBS; PHOTOLAMPS; TELEVISION SETS

spending to its record $21.2 billion in 1952 is by no means uniform throughout industry. Increases will range from 100 percent in some fields to 8 in others.

Electronics is up near the top of the list, companies having military contracts and subcontracts leading the parade and others lagging. Considering our industry overall, the opportunity for the sale of equipment and services contributing to plant expansion and modernization is great.

March IRE Show Sets Stage for Big Business Year

Services pull exhibits to conserve funds but manufacturers snap up space

INSTITUTE OF RADIO ENGINEERS' 1952 National Convention and Show coming up March 3–6 at New York's Waldorf Astoria and Grand Central Palace represents very big business indeed and will have widespread influence upon the design, production and purchase of electronic gear in the year ahead.

Registration of engineers, military brass and top industry management men is expected to exceed 25,000 during the four-day shindig publicizing the almost overwhelming total of 220 technical papers, to be presented at 43 separate sessions split between hotel and two-block-distant exhibit hall. Exhibitors signed up for the Palace (including ELECTRONICS and *Nucleonics*) total 350 and will occupy all four instead of last year's three floors, filling the big building from foundation to roof. Products to be shown are valued at $10,000,000.

IRE banquet-keynoter Charles E. Wilson, U. S. Director of Defense Mobilization and former president of General Electric. He will be at the head table, coincidentally, when GE's W.R.G. Baker receives the Institute's Medal of Honor

► **Much Manpower Involved**—Some idea of how much manpower and money is directly or indirectly wrapped up in the convention and show may be gleaned from the following facts relative to last year's electronic-industry affairs:

IRE's 1951 National Convention in New York registered 22,919 people, had 292 speakers and 277 exhibits. Western Electronic Show in San Francisco pulled 8,745 people, had 45 speakers and 151 exhibits, Electronic Parts Show in Chicago 8,498, 20 and 204. Audio Fair in New York hit 8,400 and 22 and 93—people, papers and exhibits; Instrument Society of America in Houston 6,166 and 82 and 147; American Institute of Electrical Engineers in New York 3,334 and 320 (no exhibits); Association of American Railroads Communications Section in Quebec 604 and 18 and 21; IRE Radio Fall Meeting in Toronto 550 and 24 (no exhibits) and Society of Motion Picture and Television Engineers in Hollywood 500 and 65 (no exhibits).

► **Last-Minute Switch**—Six weeks before IRE showtime, the Department of Defense pulled all Service exhibits out of the Palace floor plan despite the usual 'no-charge' donation of space, regretfully informing the Institute that the cost of preparing, shipping and manning displays could not be borne in view of slashed appropriations.

Military electronic equipment of an unclassified nature will be displayed by manufacturers in the space originally reserved for the Army, Navy and Air Force, in a special Institute-coordinated exhibit.

Color TV Field Test Underway in Philadelphia; New York Next

NTSC program uses WPTZ and WNBT. Tests go to Syracuse soon

LAST PHASE in the development of a satisfactory system of compatible color television appeared to be at hand as the National Television System Committee began field tests in Philadelphia February 12th.

According to RTMA, under whose auspices the NTSC has been examining compatible systems since 1950, FCC staff members were invited to view the images on February 16th, with facilities provided by the Philco Corporation. The Philadelphia tests are being conducted with the transmitter of WPTZ, on channel 3.

On February 25th the tests move to New York, where NBC-RCA, DuMont and Hazeltine will provide tests signals to be radiated by WNBT, channel 4, and by the DuMont uhf experimental transmitter. After a period of about two weeks, the test locale will shift to Syracuse, where a General Electric transmitter at Electronics Park will carry the signals in the vhf band.

► **Time, Participants**—The tests on WPTZ and WNBT will occur for the most part in the early morning hours, after midnight, since FCC regulations prohibit the experimental use of commercial stations during regularly scheduled program hours. The DuMont and General Electric stations, being experimental, do not fall under this ruling.

All manufacturers of tv receivers, whether or not they are members of RTMA, have been invited to take part in the tests. Although no list of those participating thus far has

(Continued on page 10)

NEW! SPRAGUE Blue Jacket* wire-wound RESISTORS

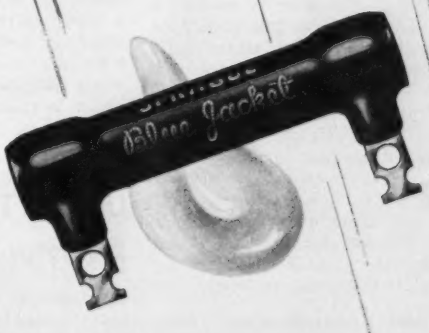
WITHSTAND SEVERE HUMIDITY!

MEET JAN-R-26A!

Designed to withstand the rigid Characteristic G humidity tests of the most stringent specification of them all—JAN-R-26A—Sprague's new Blue Jacket Wire-Wound Resistors give trouble-free service in military electronic and electrical equipment exposed to extremely damp climates!

These outstanding new members of the Sprague resistor family are now available in tab terminal styles RW29 through RW39 in wattage ratings up to 166 watts.

You'll find the complete Blue Jacket Story with performance specifications in Engineering Bulletin 110, just off the press. Get your copy without delay.



YOU'LL KNOW THESE REMARKABLE RESISTORS BY THEIR VITREOUS ENAMEL BRIGHT BLUE JACKETS

SPRAGUE

PIONEERS IN ELECTRIC AND ELECTRONIC DEVELOPMENT

*Trademark

SPRAGUE ELECTRIC COMPANY • NORTH ADAMS, MASSACHUSETTS

See Us at the IRE Show — Booths 27-28

been officially released, it is understood that experimental receivers built by Crosley, General Electric, Hazeltine, Motorola, Philco and RCA are scheduled for the Philadelphia tests, and at least four other companies were expected to test their receivers later.

▶**How the System Works**—A full technical description of the color signal used in the tests has appeared in ELECTRONICS (February, 1952, cover and p 88 and 96). Reduced to the simplest terms, the NTSC color system employs two signals, both broadcast within the standard 6-megacycle channel occupied by commercial tv stations. One of these signals is identical to the standard black-and-white signal now used in public broadcasts. The other is a 'color carrier' signal which carries the color information.

Black-and-white receivers respond only to the first signal and hence reproduce the color program in monochrome, as if they were tuned to a black-and-white transmission. Color receivers respond to both signals, producing a black-and-white image on which are superimposed the color values transmitted by the color carrier.

All of the color receivers thus far tested use tricolor picture tubes of the type developed by RCA (ELECTRONICS, p 86 May 1951). This tube has a viewing screen consisting of 600,000 color dots, 200,000 for each of the three primary colors. Three electron beams within the tube excite dots of the corresponding color, producing three superimposed images. The primary colors combine to reproduce the full gamut of colors in much the same manner as the three superimposed dye images in Kodachrome and Technicolor film.

▶**End Point**—The NTSC field tests will subject the color signal to 16 specific tests outlined by the FCC, and others formulated by NTSC.

Following a satisfactory conclusion of the tests, the system will be referred to FCC.

Extra Materials For Color TV Out, Says NPA

One group asks easing of order M-90 for theatre-tv

No additional allocations of critical materials for color tv equipment can be expected at this time, NPA officials told tv manufacturers at a second industry-government conference February 8th.

Objectors to the M-90 order contend it prohibits production of a specific item and is unnecessarily restrictive on competitive development. NPA's view is that color tv is an adaptation of an existing product and therefore must come under the general allotments for radio and television receivers.

▶**Labor Drain Discussed**—Industry estimates of the drain on labor which color television would impose varied considerably. At an October meeting, one company reported that 4 percent of its engineers were engaged in color development work. Today the same firm estimates that if commercial color equipment were permitted it would assign 16 percent of its engineers to it.

Industry's recommendations about what to do with order M-90 range from outright revocation to retention in its present form. A number of representatives propose a middle course . . . amending the order to prohibit production of home color tv receivers only. This would open the way for color television in theatres and other commercial uses.

UHF TV Transmitters Ready in Fall

ON FEBRUARY 14, at a Washington conference of broadcast consultants, it was announced that RCA is ready for the tv freeze-end with a complete line of uhf transmitters and receiving equipment.

Available in the Fall, a one-kilowatt transmitter at $65,700 is the basic unit. To this, an amplifier to increase station power to 10 kilowatts can be added for $85,000. Purchasers of the one-kilowatt job may establish priority for the high-power amplifier. Bought together, cost is $135,000.

An antenna that provides an effective radiated power of 200 kilowatts will be available in September. Cost, $17,900.

▶**For Present Receivers**—A series of uhf converter units will be available to fit conditions in different cities. A single-station unit costs about $10, a two-station adapter $25, and an all-uhf-channel unit $50. A combined vhf-uhf tuner for 16 channels that fits certain models of present set production is available.

Consultants attending the seminar at the Statler Hotel were told that RCA facilities will be made available to them at cost for making uhf field-strength measurements.

Boomlet in Marine Radio Business

Acceptance of Safety Convention to change FCC requirements

A FLURRY of new equipment business in the maritime radio field is forecast now that fifteen nations have finally accepted the International Convention for the Safety of Life at Sea, proposed in London in 1948. Biggest item of new business will be lifeboat radiotelegraph sets. Next are radiotelephones for cargo ships between 500 and 1,600 gross tons with no radio at present.

Ships of United States registry, working under Federal Communications Commission rules, are already better equipped than most.

▶**Many After Business**—The 'Big Two', Mackay Radio and Telegraph Co., IT&T affiliate, and Radiomarine Corporation of America, branch of RCA, hope to whack up the lion's share of the lifeboat market, despite stiff competition from five or six other companies. A feature of the required lifeboat rig will be a precision automatic keyer to set off the auto-alarm of any ship within range.

More competition is expected in

(Continued on page 14)

REDUCING DIET

for electronic equipment

Centralab shows you
a complete line of Controls,
Switches, Capacitors and Printed Electronic Circuits
in the *smallest* sizes and in the ratings
needed to help you MINIATURIZE nearly all
types of Electronic Equipment

For more information on how Centralab Printed Electronic Circuits can offer you big savings . . .
see next two pages ➡

CENTRALAB PARTS CUT DOWN

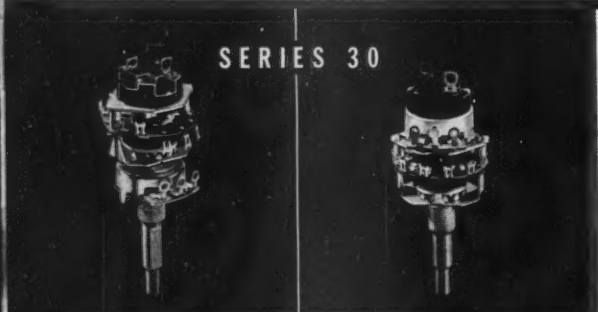
OF TV-AM-FM AND

Whatever your need in modern miniature size controls, switches, ceramic capacitors or printed electronic circuits — you'll find Centralab your best source of supply . . . for standard components or special adaptations. For technical bulletins — check corresponding numbers in coupon below. For engineering assistance write factory direct — state your problem.

MINIATURE CONTROLS

You can rely on Centralab for the smallest in controls. The Model 1, illustrated here is literally the standard for the hearing aid industry — where small size and smooth, noiseless, reliable performance is of paramount importance. What's more, Model 1 controls now are being used widely for miniaturization of several types of military electronic equipment.

Model 1 variable resistor — a truly miniature unit . . . no bigger than a dime! Available in standard or new Hi-Torque types . . . either type with or without off-on switch. Also available with slot—front or rear—for screw-driver adjustment. New high torque units will hold settings under conditions of vibration or shock. Check No. 42-158 on coupon.



Combination Series 30 miniature switch unit with dual concentric shaft — permits independent operation of switch, off-on switch, and Model 2 variable resistor.

Same combination unit as shown at left, *except* that Model 2 variable resistor is mounted at rear of miniature switch. Position of resistor provides convenience of wiring.

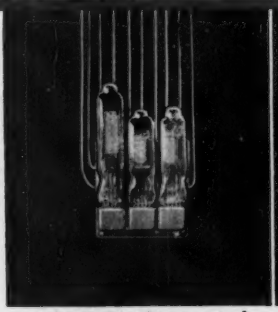
Also available with dual switches operated independently with dual concentric shafts.

MINIATURE CAPACITORS

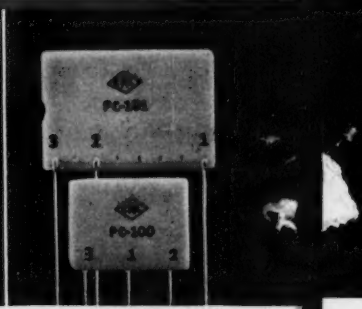
Centralab ceramic capacitors make possible tremendous savings in space; many of them are 1/7th the size of ordinary capacitors. This is particularly important where new design requirements call for less bulk. What's more, they provide a permanence never before achieved with old-fashioned paper or mica condensers. The ceramic body provides imperviousness to moisture, plus unmatched ability to withstand temperatures generally encountered in electrical apparatus. You can rely on Centralab ceramic capacitors for close tolerance, high accuracy, low power factors, and temperature compensating qualities as required.

PRINTED ELECTRONIC CIRCUITS

Printed Electronic Circuits are complete or partial circuits (including all integral circuit connections) consisting of pure metallic silver and resistance materials fired to CRL's famous Steatite or Ceramic-X and brought out to convenient, permanently anchored external leads. They provide miniature units of widely diversified circuits—from single resistor plates to complete speech amplifiers. No other modern electronic development offers such tremendous time and cost saving advantages in low-power applications. *Important to note:* All PEC's illustrated are developed for standard applications. Numerous other circuit complements can be furnished for volume requirements.



New Model 3 Ampec — a sub miniature 3 stage speech amplifier . . . dimensions: 1-1/32" x 15/16" x 11/32". Check coupon for Technical Bulletin 42-130.



82% less soldered connections with Vertical Integrator . . . in assembly of TV vertical integrator networks . . . reduces 16 soldered connections to 3! Technical Bulletin 42-126.

SIZE-SPACE-WEIGHT- AND COST

MILITARY ELECTRONIC GEAR

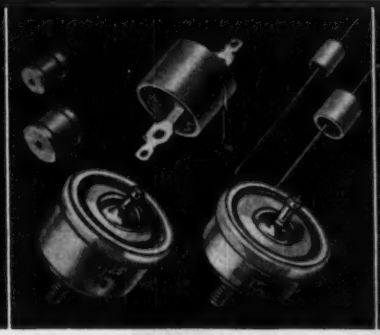
MINIATURE SWITCHES

Centralab's new miniature Series 20 and Series 30 switches have been specifically designed to meet the modern trend toward greatly reduced size for high-frequency, low-current applications. Extremely compact design and small size, plus availability of separate sections and index assemblies, provide an adaptability that is invaluable to design engineers and manufacturers. For complete information on the new Centralab Miniature Series 20 and Series 30 Switch line . . . multi-pole, multi-position, multi-section models or combinations with attached line switches and variable resistors, mail the coupon today. *Manufacturer's samples promptly.* Bulletins 42-63 and 42-164.

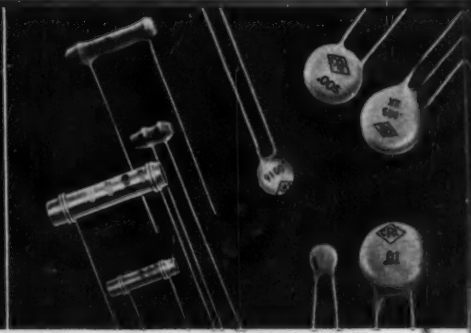
New Centralab Series 20 miniature switch, single steatite section. Available in 2 to 11 positions with stops, or 12 position continuous rotation—and with multiple sections.

Here's standard Series 20 miniature switch with standard shaft and phenolic section with off-on switch added. Also available with multiple sections.

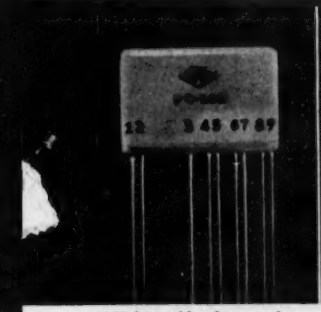
NEW Eyelet-Mounted Feed-through Ceramic Capacitors are exceptionally small. Capacities range from 25 to 3000 mmf., Voltage rating. 500 V. D. C. W. Check No. EP-15 in coupon.



Centralab's Type 850 high voltage ceramic capacitors are especially designed for high voltage, high frequency circuits. Centralab's Type 930 high accuracy ceramic capacitors are especially developed for exacting electronic applications. Bulletins: 42-102 and 42-123.

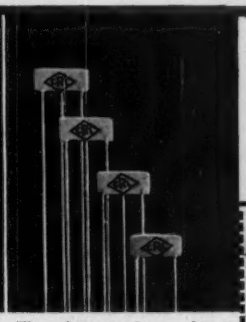


Ceramic Disc Hi-Kap Capacitors have very high capacity in extremely small size. Bulletin No. 42-4R. TC Tubulars (Temperature Compensating) — TCZ units show no capacity change over wide range of temperature; TCN's vary capacitance according to temperature. Bulletin No. 42-18. BC (Bypass Coupling) Tubulars . . . well suited to general circuit use. Bulletin No. 42-3.



50% less soldered connections with Centralab's new Pendet... 5 capacitors and 4 resistors in a single plate...couples diode-triode and pentode tubes in output stage of AC-DC sets. Technical Bulletin 42-149.

50% less soldered connections with Centralab's Audet . . . furnishes all values of all components generally found in the output stage of AC-DC radio receivers. Technical Bulletin 42-129.



Tiny plate capacitor, resistor, and resistor-capacitor units. Readily fit all types of miniature and portable electronic equipment. Technical Bulletin 42-24.

Centralab

Division of GLOBE-UNION INC.

914 E. Keefe Avenue • Milwaukee 1, Wis., U. S. A.

Centralab, Div. of Globe-Union Inc.
914 East Keefe Avenue, Milwaukee 1, Wisconsin

☐ 42-3	☐ 42-102	☐ 42-130	☐ 42-164
☐ 42-4R	☐ 42-123	☐ 42-149	☐ EP-15
☐ 42-18	☐ 42-126	☐ 42-158	-
☐ 42-24	☐ 42-129	☐ 42-163	-

Name_____

Address_____

Company_____

Title_____

the radiotelephone field, where a large number of manufacturers are already supplying equipment for small-craft operations around two megacycles (off the high-frequency end of the broadcast band).

RMCA and Mackay spokesmen point out that while the provisions of the international agreement are known, the FCC, which calls the tune for U. S. manufacturers, has not yet issued rules or set specifications. Even though the Convention comes into force in November, it may take another couple of years to run the gamut of design, type approval and manufacture-during-shortages.

Government Relations Unit Set Up By RTMA

ESTABLISHMENT of a government-relations division to deal with the problems of electronics manufacturers handling government contracts is announced by the reorganized Transmitter Division of the Radio-Television Manufacturers Association. The new division, headed by Ben Edelman, Western Electric, will also aid companies from other fields now turning to electronics manufacturing.

Navy Electronics No Bottleneck

INDUSTRY was turning out electronic equipment for the Navy at the rate of $1.5 billion annually at the end of 1951. By July 1, 1952 (beginning of the 1953 military fiscal year) production is expected to double, according to Captain W. I. Bull, Chief of the Electronics Division, Office of Naval Materiel.

Production of electronic equipment for the Navy is 27 percent behind schedule. This constitutes no bottleneck, however, since new ships, airplanes and shore installations are not yet ready to receive their full complement of equipment.

JTAC Surveys Crowded Radio Spectrum, Recommends Conservation Measures

Report by 25 experts compares present allocations with ideal

SOON to be issued by the Joint Technical Advisory Committee (RTMA-IRE) is a 250-page magnum opus titled "Conservation of the Radio Spectrum", which spells out the status quo of the multi-billion-dollar radio-tv industry. It predicts a stagnant future if present allocation practices are continued.

The six-part report was compiled by a three-man subcommittee assisted by five consultants and 17 additional contributors, each of whom rates as an expert in some part of the field. Written in laymen's language, the report traces the history of radio regulation since the turn of the century, and defines the facts of nature (propagation characteristics) which must be recognized in assigning spectrum space.

▶**Action Urged**—JTAC brashly sets out an ideal allocation which would make best use of available facilities, on the assumption that the existing channels could be reassigned without reference to the past. The existing allocation is then compared with the ideal and the less-than-ideal practices of the present are subjected to rational criticism.

A specific program for amelioration of present difficulties is presented under the title "Dynamic Conservation". The proposed program notes the unavoidable handicaps imposed by concentrations of population and propagation vagaries, but lists specific technical and economic measures which should, in JTAC's view, be adopted at once by the FCC and similar agencies throughout the world.

Plans for reproducing the report for worldwide distribution, possibly in book form, were discussed at the February 15th meeting of JTAC.

▶**Men Behind Report**—Among those contributing to the report were Haraden Pratt, now Telecommunications Adviser to President Truman, Philip Siling, RCA Frequency Bureau head, and Donald G. Fink, ELECTRONICS editor, who headed the JTAC subcommittee.

Consultants appointed to JTAC for the project included J. H. Del-

(Continued on page 16)

INDUSTRIAL TELEVISION HELPS SELL NEW CARS

Dealers and salesmen in the jampacked 1,200-seat ballroom of Atlantic City's Hotel Traymore saw their 1952 line for the first time on a 15-by-20-foot theatre-tv screen. The cars were televised over a closed circuit from a nearby garage by (left to right) Ford's Johnston and Beacham, RCA-Victor's Doug Deakins

(Advertisement)

New BARRY Products on Display at I. R. E. Show Booths 284-285

Watertown, Mass., Feb. 1, 1952 — New equipment for isolating vibration, controlling shock, and performance-testing vibration isolators and shock mounts themselves, will be shown in operation at the Barry exhibit on the second floor of the exhibition hall, during all of the 1952 I. R. E. show.

All-Metl Barrymounts.

A complete line of All-Metl unit isolators, and of equipment mounting bases incorporating these isolators for all JAN-standard sizes of electronic equipment, will also be exhibited. Data on the performance characteristics of these mounts, which are specifically designed to withstand extremes of high and low temperature, will be available to those interested.

Ruggedized Mounts and Bases.

Ruggedized versions of Barrymounts and bases, in the All-Metl and Air-Damped types, will be shown. These units meet the latest military specifications for protection against shock. They are designed to hold mounted equipment securely through the most severe shocks encountered in the operation of carrier-based aircraft, and even in crash landings.

Miniaturized Vibration Isolators.

In line with the current trend toward smaller and smaller airborne equipment, Barry engineers have developed a line of miniature isolators. These are available in both the All-Metl and the Air-Damped types, and combine maximum performance with minimum loss of space. They will be on display, together with special bases available to incorporate them.

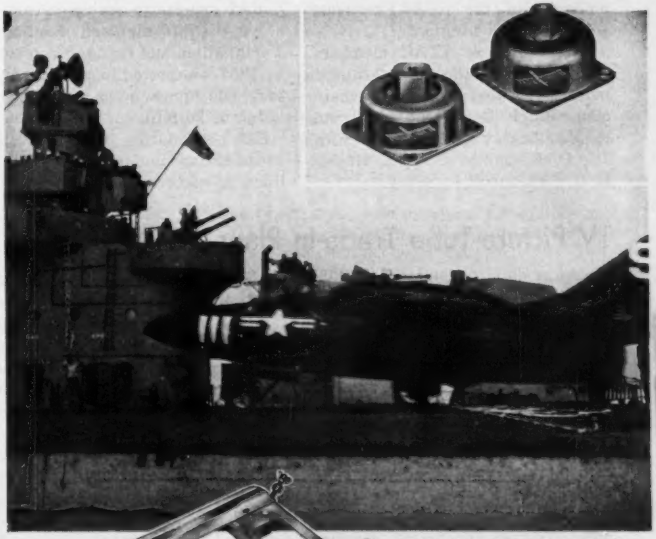
Shock Test Machine.

A working demonstration of the new Model 20-VI Impact-shock Testing Machine will be conducted at frequent intervals. This will enable visitors to see for themselves what is involved in laboratory tests of vibration isolators, shock mounts, and mounted equipment. Experienced Barry Personnel will be on hand at all times to demonstrate and discuss the apparatus, and to answer questions about the control of shock and vibration.

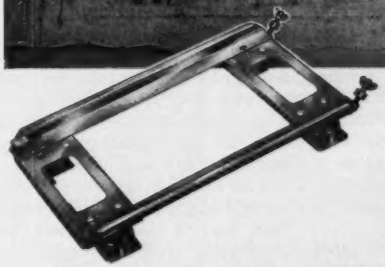
SHOCK and VIBRATION NEWS

BARRYMOUNTS FOR ASSURED CONTROL OF SHOCK AND VIBRATION

can YOUR equipment stand the shock of carrier landings? Barrymounts can!



Official United States Navy Photograph



New military specifications for all services require ruggedization of your equipments with their mountings.

Ruggedized Air-damped and All-Metl Barrymounts and mounting bases are now available to meet the shock test requirements of specifications MIL-T-5422 (Aer), MIL-E-5272 (USAF), and AN-E-19. These mountings hold your equipment securely and maintain uniform performance characteristics even after the repeated shock of many aircraft carrier landings.

For full information about Barrymounts and bases, write today for your free copy of each of these Barry catalogs:

Catalog #524—Ruggedized Barrymounts and ruggedized mounting bases.

Catalog #523—Air-damped Barrymounts and mounting bases.

Catalog #509—All-Metl Barrymounts and mounting bases.

THE **BARRY** CORP.

707 PLEASANT ST., WATERTOWN 72, MASSACHUSETTS

SALES REPRESENTATIVES IN

Atlanta Chicago Cleveland Dallas Dayton Detroit Los Angeles Minneapolis New York Philadelphia Phoenix Rochester St. Louis San Francisco Seattle Toronto Washington

linger, generally regarded as dean of propagation specialists here and abroad, G. C. Southworth of the Bell Labs, A. F. Van Dyck of RCA and former IRE President, Trevor H. Clark, now of Southwestern Research Institute, and James P. Veatch, former FCC engineer now manager of the RCA Frequency Bureau in Washington.

The roster of JTAC members, who approved the report unanimously included I. J. Kaar, chairman, Ralph Bown, vice-chairman, A. V. Loughren, T. T. Goldsmith, Jr., D. B. Smith, J. V. L. Hogan, D. G. Fink and P. F. Siling.

Italian TV Approved

ITALIAN authorities have approved a television broadcasting license for the RAI (Radio Audizioni Italiane), a private company, on condition it come under direct state control.

RAI expects to set up television service within eighteen months in Turin, Milan and Rome. TV service by 1957 is expected to cover an area of 56,000 square miles with a population of 26 million.

The standards for television broadcasting in Italy will be 625-lines, 25 pictures per second.

TV Picture-Tube Trade-In Plans Stir Industry

Price of glass envelopes appears to be the motivating force behind the move

SYLVANIA late last month startled the tv industry by quietly offering its dealers a trade-in allowance, ranging from $2.25 to $5.25, on used picture tubes. First move by a major tube maker along these lines, the announcement came in for close scrutiny by other leading manufacturers, many of whom had been toying with the idea. National Union immediately followed suit. Others appear to be on the verge of doing so.

The story behind the news is this:

Independent firms scattered around the country have profitably salvaged many picture tubes for distributors, dealers and consumers by (1) reactivating tired electron-emitting cathodes, electrically 'flashing' them from the outside base pins, (2) removing gas by breaking the vacuum seal and repumping, and reactivating cathodes by electro-chemical means, or (3) removing everything from the glass envelope, cleaning it, and putting in a new electron gun and phosphor screen.

▶**Rebuilts Compete**—There is considerable technical doubt as to the efficacy of the first-mentioned method of extending tube life and a widespread difference of opinion among engineers even regarding the second. But the third method really disturbs tube makers.

Glass envelopes represent a substantial part of the cost of picture tubes, and suppliers have been slow to reduce it. Most manufacturers have for some time reworked the good envelopes of tubes rejected during production for internal faults, saving the consumer up to 25 percent by so doing. Where the glass itself is not damaged a rebuilt tube may conceivably be as good or better than a new one, depending upon the skill of the builder; and some shops are now selling rebuilts as low as $1 per tube inch, about 50 percent of the prevailing new-tube lists, largely because they buy their glass cheap.

Rebuilt picture tubes are thus competing with new ones in the replacement market.

▶**Tube-Makers Fight Back**—Whether or not major manufacturers establishing a picture-tube trade-in policy will actually re-use many of the glass envelopes so obtained remains to be seen. There is no shortage of new envelopes, so their price will probably be the determining factor.

The apparent reason for buying up used tubes is to remove them from the reach of firms that do not obliterate the original maker's name when rebuilding, a common practice currently under investigation by a battery of corporation and Association lawyers.

Except insofar as the acceptance of trade-ins implies a cut price, there does not appear to be any desire on the part of major manufacturers to start a tv picture-tube price war among themselves.

What Happens To Drafted Engineers?

INDUSTRY has asked "what happens to drafted engineers" and raised another question—"will my engineer use his talents in military service?" ELECTRONICS can supply management with an answer to these questions after talking to Colonel Thomas A. Pitcher, Commanding Officer, Fort Monmouth, Officer Candidate School.

Army's reopening of Signal Corps OCS provides the opportunity for drafted technical men to become engineering officers and receive assignments in line with their civilian occupations.

Officer Candidate William Foland, formerly with the Bell System in Missouri and a graduate of University of Missouri, is one of the engineers graduating as 2nd lieutenant this month at Fort Monmouth Signal Corps Officer Candidate School. Foland is shown here tuning an SCR 499 as part of his communications center training

Of the 140 candidates graduating this month, 5 percent hold college engineering degrees; 16 percent have had two or more years of college but did not receive a degree, and 26 percent have had electronic experience or training in private industry.

▶**Training Provided**—Taking 22 weeks of rigid training, one por-

(Continued on p 18)

NEW *a-c operated* megohmmeter

½ to 2,000,000 megohms ***with Constant 500 Volts Across Unknown***

RUGGED ☆ PORTABLE ☆ ACCURATE ☆ SIMPLE TO USE

SIMPLE TO USE — *Minimum of panel controls for inexperienced personnel . . . value of unknown is product of meter reading and multiplier switch setting*

SAFE TO USE — *In the DISCHARGE position of panel switch all voltage is removed from terminals, allowing connections to be made or broken with complete safety*

CONSTANT 500-VOLTS APPLIED TO UNKNOWN — *the standardized voltage level for these measurements — balanced vacuum-tube voltmeter indicating circuit with glow-discharge type of voltage regulator tube and stabilized 500-volt supply — voltage on unknown is held at 500 to within ± 2% over a 105- to 125-volt supply line range*

RAPID MEASUREMENTS OF CAPACITOR LEAKAGE — *in the DISCHARGE switch position a shunt resistor is automatically connected across the UNKNOWN terminals, removing any residual charge in capacitive component of the unknown . . . this feature is especially useful when measuring leakage resistance of capacitors*

NOT NECESSARY TO CHARGE UNKNOWN *before starting measurements, as circuit resistance is so small that it has negligible effect on charging time of even largest capacitors*

VERY CONVENIENT IN OBSERVING APPARENT LEAKAGE RESISTANCE *after one and ten minutes of charging time, as is done commonly as routine checks on large electrical machines*

"CHECK" SWITCH POSITION PROVIDED *for checking calibration . . . controls provided for readjustment, normally required only when tubes are changed*

GUARD AND GROUNDING TERMINALS *provided, in addition to the two unknown binding posts, for making three-terminal resistance measurements . . . ground terminal can be connected either to guard terminal or to one of the UNKNOWN terminals*

ACCESSORIES SUPPLIED — *Two color-coded test leads with phone tips, two insulated probes, two alligator clips and a G-R Type 274-MB Plug*

For General-Purpose Resistance Measurements

☆ ***in Production***

☆ ***in the Repair Shop***

☆ ***in the Field***

For Insulation Resistance Tests

on Transformers ☆ Capacitors Cables ☆ Rotating Electrical Machines ☆ Household Appliances

Type 1862-A Megohmmeter: $225.

GENERAL RADIO Company

275 Massachusetts Avenue, Cambridge 39, Mass.

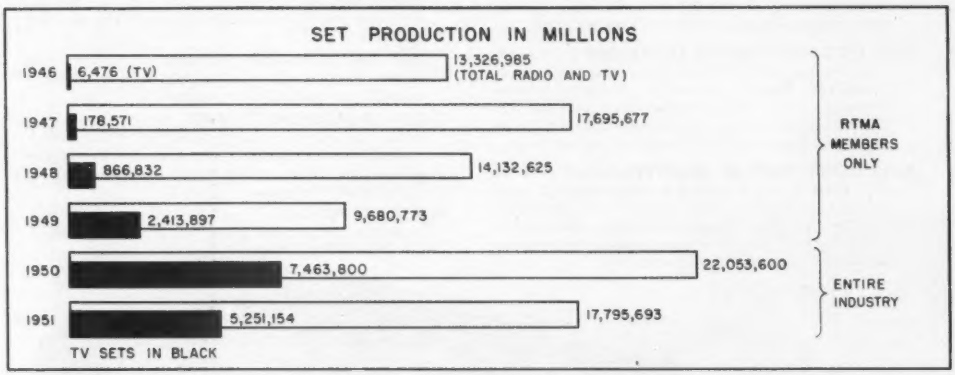
tion of instruction entails 345 hours of Signal Subjects. Then 49 hours are spent in learning the complete operation of a communications center; 44 hours cover radio theory; 30 hours are given in ac-dc theory, while the remaining 222 hours are given over to allied subjects in the electronics fields. Upon completion of the academic courses, the candidate spends a week in the field under simulated 'official assignment.'

▶ **Tip To Industry**—If you have an engineer or technician about to be drafted into the Army he should complete basic training (13 weeks) and then apply for admittance to Officer Candidate School (specifying the Signal Corps) if he meets these requirements: 18½—28 years of age, at least a completed high school education (college will count more toward admittance), and a good moral character and mental ability.

U. S. Radio Set Exports Up 103 Percent

REPORT just released by the Foreign Section, Electronics Division, NPA, reveals that exports of radio sets to foreign countries, in 1951, increased 103 percent over the previous year.

Of 57 countries supplying information for the report, twenty-eight indicate their principal source of supply of radio sets is the U. S.



What's Behind the Figures—RTMA Monthly Radio-TV Set Production

First of a series of fuller explanations of ELECTRONICS' statistics

INQUIRIES from readers indicate a desire to know the basis of the statistics reported monthly on the "Figures of the Month" page (p 4). Accordingly, following the statement last month describing the *Electronics Output Index* graph, the editors have prepared a series of brief explanations of the various other entries on that page.

First of the eleven divisions on the page beneath the graph is "Radio Set Production", which lists the monthly production reports of the Radio-Television Manufacturers Association. The RTMA release is broken into four categories: tv sets of all types including combinations; home radio sets; battery portable sets; and auto sets. The figures are compiled under the direction of W. F. Long, RTMA Director of Statistics in the Washington office of the Association. They comprise production reports of RTMA member companies for the month in question, and are today adjusted to include the production of the entire industry, including manufacturers not members of RTMA. Prior to January 1950, the figures represent production of RTMA member companies only.

The figures represent production over four- or five-week periods, depending on the length of the month. Consequently, production for the current month cannot always be compared directly with that of the previous month or the same month a year ago. (The same caution applies to comparisons between set production for a given month and set sales, listed immediately beneath, in the same or a later month. There is normally a lag between production and sales of the order of several weeks to several months even when sales are brisk. Moreover, differences between production and sales result when sets are put into or taken out of inventory in manufacturer's or distributor's warehouses.

▶ **Detailed Breakdown**—Plotted in the accompanying diagrams are production figures reported by RTMA in past years. The post-war period 1946-1951 is charted in the bar diagram. Tv production started in 1946 with a mere 6,000 sets, rose in 1950 to over 7 million, and fell back as consumer demand slackened to about 5.25 million last year. Radio set production (home, portable and auto sets combined) was highest immediately following the war, has since fallen off to about two thirds

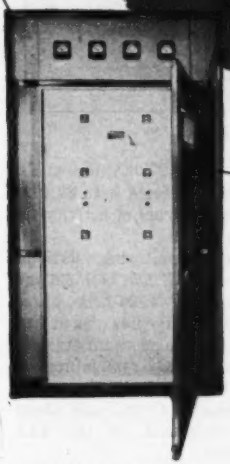
(Continued on page 20)

Go on the Air to Stay

with JOHNSON

ANTENNA PHASING EQUIPMENT

ANTENNA AND TRANSMITTER COMPONENTS



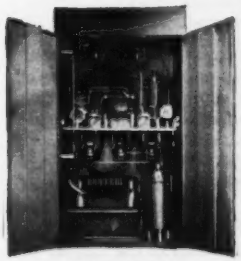
Typical Johnson Antenna Phasing Equipment

Hundreds of Johnson phasing installations are on the air — to stay — for you can depend on JOHNSON for the best! Designed especially for your station, and incorporating the recommendations of your consulting engineers, JOHNSON phasing equipment offers a host of advantages. It has optimum circuit design, heavier components, automatic switching from directional to non-directional operation, and others.

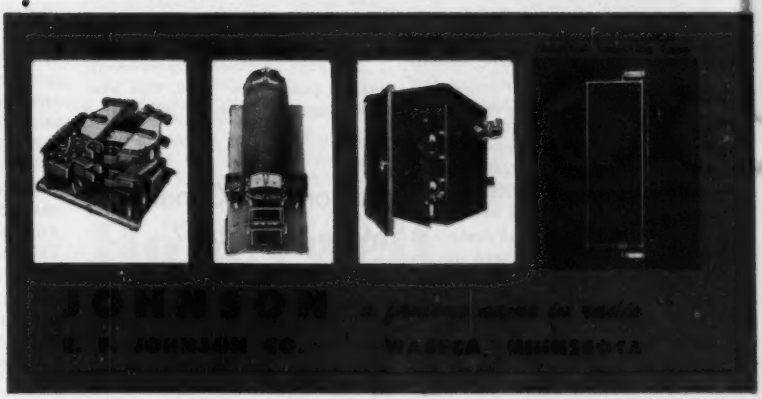
OTHER JOHNSON BROADCAST EQUIPMENT

- Adjustable Phase Sampling Loops
- Isolation Filters
- Sampling Lines
- FM and AM Concentric Lines
- Fixed Capacitors
- Variable Capacitors
- Standing Wave Indicators
- R F Contactors
- Tower Lighting Filters
- Transmission Line Supports
- Pressurized Capacitors
- Neutralizing Capacitors
- Fixed Inductors
- Variable Inductors
- Feed-Thru Bowl Assemblies
- Make Before Break Switches

Write for specific information directly or through your consulting engineer



Interior view of Phasing Equipment



JOHNSON — a powerful name in radio

E. F. JOHNSON CO. — WASECA, MINNESOTA

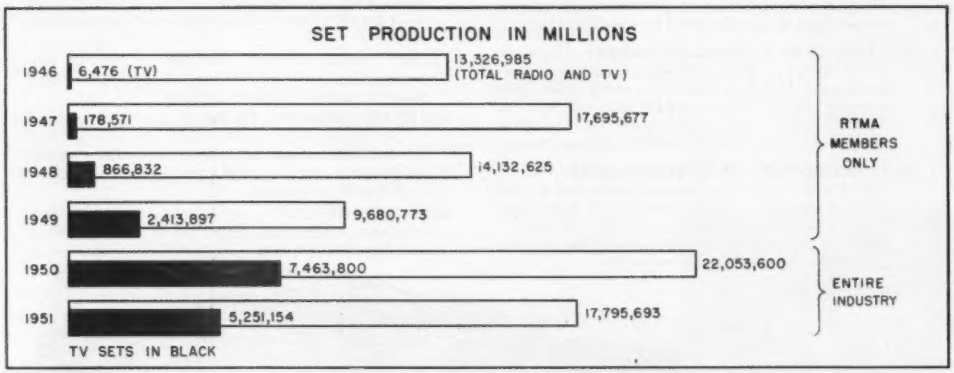
tion of instruction entails 345 hours of Signal Subjects. Then 49 hours are spent in learning the complete operation of a communications center; 44 hours cover radio theory; 30 hours are given in ac-dc theory, while the remaining 222 hours are given over to allied subjects in the electronics fields. Upon completion of the academic courses, the candidate spends a week in the field under simulated 'official assignment.'

▶ **Tip To Industry**—If you have an engineer or technician about to be drafted into the Army he should complete basic training (13 weeks) and then apply for admittance to Officer Candidate School (specifying the Signal Corps) if he meets these requirements: 18½—28 years of age, at least a completed high school education (college will count more toward admittance), and a good moral character and mental ability.

U. S. Radio Set Exports Up 103 Percent

REPORT just released by the Foreign Section, Electronics Division, NPA, reveals that exports of radio sets to foreign countries, in 1951, increased 103 percent over the previous year.

Of 57 countries supplying information for the report, twenty-eight indicate their principal source of supply of radio sets is the U. S.



What's Behind the Figures—RTMA Monthly Radio-TV Set Production

First of a series of fuller explanations of ELECTRONICS' statistics

INQUIRIES from readers indicate a desire to know the basis of the statistics reported monthly on the "Figures of the Month" page (p 4). Accordingly, following the statement last month describing the *Electronics Output Index* graph, the editors have prepared a series of brief explanations of the various other entries on that page.

First of the eleven divisions on the page beneath the graph is "Radio Set Production", which lists the monthly production reports of the Radio-Television Manufacturers Association. The RTMA release is broken into four categories: tv sets of all types including combinations; home radio sets; battery portable sets; and auto sets. The figures are compiled under the direction of W. F. Long, RTMA Director of Statistics in the Washington office of the Association. They comprise production reports of RTMA member companies for the month in question, and are today adjusted to include the production of the entire industry, including manufacturers not members of RTMA. Prior to January 1950, the figures represent production of RTMA member companies only.

The figures represent production over four- or five-week periods, depending on the length of the month. Consequently, production for the current month cannot always be compared directly with that of the previous month or the same month a year ago. (The same caution applies to comparisons between set production for a given month and set sales, listed immediately beneath, in the same or a later month. There is normally a lag between production and sales of the order of several weeks to several months even when sales are brisk. Moreover, differences between production and sales result when sets are put into or taken out of inventory in manufacturer's or distributor's warehouses.

▶ **Detailed Breakdown**—Plotted in the accompanying diagrams are production figures reported by RTMA in past years. The post-war period 1946-1951 is charted in the bar diagram. Tv production started in 1946 with a mere 6,000 sets, rose in 1950 to over 7 million, and fell back as consumer demand slackened to about 5.25 million last year. Radio set production (home, portable and auto sets combined) was highest immediately following the war, has since fallen off to about two thirds

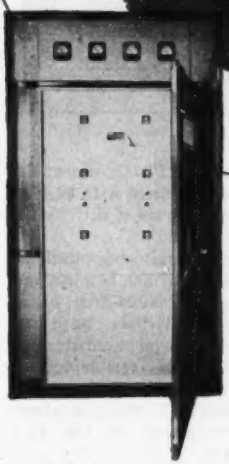
(Continued on page 20)

Go on the Air to Stay

with JOHNSON

ANTENNA PHASING EQUIPMENT

ANTENNA AND TRANSMITTER COMPONENTS



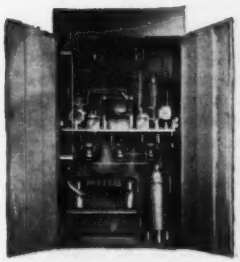
Typical Johnson Antenna Phasing Equipment

Hundreds of Johnson phasing installations are on the air — to stay — for you can depend on JOHNSON for the best! Designed especially for your station, and incorporating the recommendations of your consulting engineers, JOHNSON phasing equipment offers a host of advantages. It has optimum circuit design, heavier components, automatic switching from directional to non-directional operation, and others.

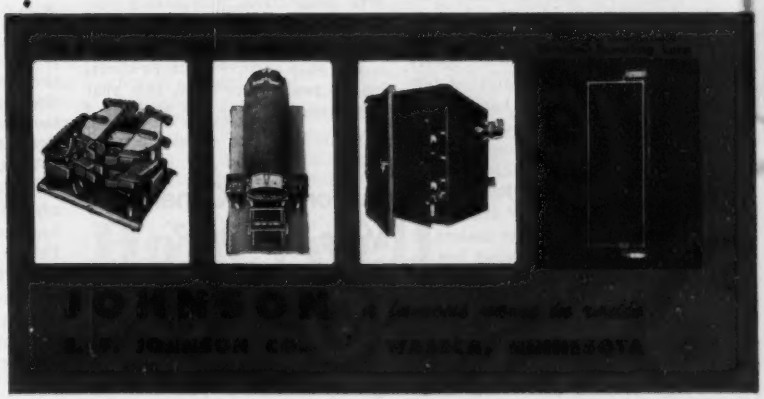
OTHER JOHNSON BROADCAST EQUIPMENT

- Adjustable Phase Sampling Loops
- Isolation Filters
- Sampling Lines
- FM and AM Concentric Lines
- Fixed Capacitors
- Variable Capacitors
- Standing Wave Indicators
- R F Contactors
- Tower Lighting Filters
- Transmission Line Supports
- Pressurized Capacitors
- Neutralizing Capacitors
- Fixed Inductors
- Variable Inductors
- Feed-Thru Bowl Assemblies
- Make Before Break Switches

Write for specific information directly or through your consulting engineer



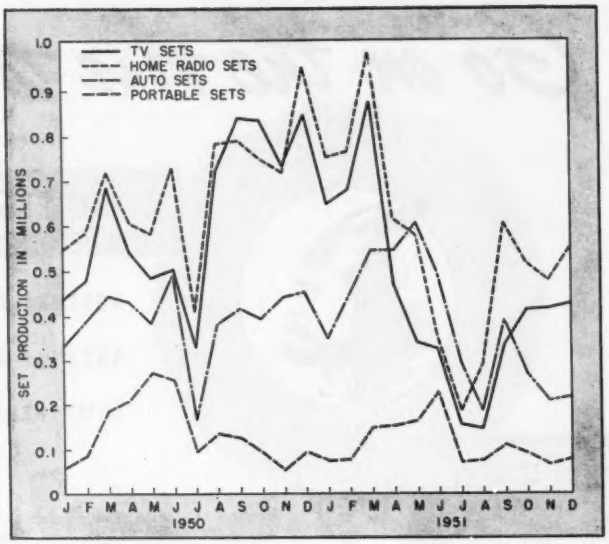
Interior view of Phasing Equipment



its peak level. The total production of radio and tv sets combined, noted at the right of each bar, fell to a low of 9.6 million in 1949, reached a peak of 22 million in 1950, and dropped to 18 million in 1951.

The trend chart for the period 1950-51 shows the production of tv, home, auto and portable sets by months. It is generally believed that the slump of the spring and summer in 1951 applied primarily to tv sets, but the chart shows that production of all classes of sets suffered in about the same proportion during that period. The production records of tv and home radio sets follow almost identical patterns during this two-year period.

The trend chart also shows the interesting fact that industry production levels at the start of 1952 were very closely the same, in all classes of sets, as at the start of 1950.



Surplus Business Booming Says ISD, Dealers

First Surplus Show sees $$$$$ and goods change hands

SURPLUS BUSINESS is here to stay, says Morris Cohen, vice-president of the Institute of Surplus Dealers. Backing his statement were thousands of people who roamed through the first cooperative exhibit the dealers have held, in New York.

Value of products shown amounted to over $100 million, according to the Institute. Some military equipment was offered at as low as 1 percent of its initial cost.

With all the bustle and appearance of big deals in the making, few of the businessmen on hand at the show were willing to discuss, for publication, how business was going. Not satisfied with this impasse, your reporter visited "Radio Row" in downtown New York and talked with some of the surplus dealers at their stores. All preferred not to be mentioned by name, nor would any of them say what was a 'hot item' now, in fear that it might raise the price among the others. However, each of them expressed an opinion on business conditions since 1945 and it boiled down to this:

Surplus business boomed immediately following the second world war. From 1947 to 49 business dropped because of the return to mass factory production of civilian goods. Many dealers went bust speculating too heavily. Big outfits bought up smaller ones to have "goods on hand." The year 1950 saw the rise again of surplus dealers with the start of the Korean war. Factories went back to military production, patronizing surplus dealers with needed critical stock on hand.

ISD says surplus business should hit its peak, since 1946, this year and stay that way for at least 5 years.

Millions for Conelrad, More FCC Staff?

INTERESTING budget item asked by Federal Communications Commission for Conelrad, control of all electromagnetic radiation (communications, broadcasting and tv) by Presidential order, forecasts expenditure of $3,627,035 in next fiscal year as contrasted with $2,484,994 for similar types of activity for the current period.

Additional monitoring stations, more personnel to man both old and new stations on a 24-hour basis, enforcement activities such as searching out illegal radio stations and investigating complaints of violations are among the less spectacular items FCC will talk about now as recipients of the $1.1 million asked.

Engineer Shortage Still Acute

A STUDY of classified newspaper advertisements seeking the services of electronic engineers indicates that the manpower problem is still acute in the field of electronics.

West Coast manufacturers are running the greatest number of ads, with 34 appearing in one Los Angeles Sunday newspaper alone. This is attributed to the number of aircraft plants located in California, and the extreme importance currently placed on the electronics side of aviation.

Second heaviest advertising area

(Continued on page 22)

Consider these

Brown Electronic Components

Brown Converters are precision, vibrator-type converters for use with any system requiring the conversion of low power direct voltage signals of the order of 100 microvolts to 60 or 400 cycle alternating voltages.

The Brown 60 Cycle Balancing Motor combines reversibility and low inertia . . . is designed to have a tapered curve of speed versus voltage and, at the same time, to maintain high torque at low speeds.

The ElectroniK Amplifier is a precise, rugged and reliable "continuous balance" system which is rapidly becoming the heart of a host of devices and apparatus requiring automatic zeroing or standardizing.

. . . in research, testing and other applications

Great numbers of these special Brown Electronic Components are daily playing a vital role in the efficient and effective performance of a variety of servos. Just like the thousands of modifications of the *ElectroniK* Potentiometer which are serving in extensive programs of scientific research and development . . . the qualities of these components are recognized and valued not only in the laboratory but also by a growing list of manufacturers of highly sensitive research equipment.

Your own development program may benefit from such specialized instrumentation and tools for research. Our local engineering representative is qualified to discuss your requirements . . . and he is as near as your phone.

MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, 4428 Wayne Ave., Philadelphia 44, Pa.

MINNEAPOLIS
Honeywell
BROWN INSTRUMENTS
First in Controls

● *Important Reference Data*

Write for Data Sheets No. 10.20-1, 10.20-2, and 10.20.3 . . . and for Bulletin 15-14, "Instruments Accelerate Research."

is the East Coast, with Boston Sunday papers having 19 ads, Baltimore 12 and Hartford 4.

A surprising statistic appeared in the study of Chicago papers. This city had only 3 advertisements for electronic engineers.

The Market for TV Components

Breakdown of parts in typical model is projected by ELECTRONICS

BEST GUESSTIMATE is that 4 million television sets will be made this year.

ELECTRONICS selected a new 17-inch table model considered typical in design, took it apart down to the last nut and bolt and counted every item. Multiplying items by 4 million gives a good working picture.

Parts strictly electronic or electrical in nature, suitable primarily for tv and radio, will total nearly 1.4 billion pieces. Over 432 million feet of hookup wire, and more than 1.2 million pounds of solder, will be needed. Mechanical parts will exceed 1.6 billion in number.

► **In Detail**—Breaking down the telephone-number totals, these parts will be required for 1952 tv receiver production:

Tubes	84,000,000
Resistors	520,000,000
Capacitors	436,000,000
Controls	28,000,000
Coils (r-f, i-f, etc.)	160,000,000
Cores (coil-tuning)	64,000,000
Transformers (reactors, yokes etc.)	28,000,000
Rectifiers (metallic)	8,000,000
Knobs	32,000,000
Bolts, eyelets, nuts, rivets, staples, washers	1,184,000,000
Braces, brackets, clamps, clips, mounting plates, straps, supports	128,000,000
Hubs, pins, pulleys, shafts, sleeves, spacers, sprints, stops	64,000,000
Shields	20,000,000
Terminal boards, lugs, strips	148,000,000
Cushions, grommets, insulators	80,000,000

MEETINGS

MARCH 3–6: IRE National Convention, Waldorf-Astoria Hotel and Grand Central Palace, New York, N. Y.
MARCH 11: Fifth National Plastics Exposition, Convention Hall, Philadelphia, Pa.
MARCH 20–21: First Conference on Cooling of Airborne Electronic Equipment, Ohio State University, Columbus, Ohio.
MARCH 30: Sixth Annual NARTB Broadcast Engineering Conference, and 30th Annual Convention of NARTB, Stevens Hotel, Chicago, Ill.
APRIL 7–9: Radio Component Show, Grosvenor House, Park Lane, London, W1, England.
APRIL 16–18: Audio-to-Microwaves Symposium, Engineering Societies Building, 33 West 39th St., N. Y., N. Y.
APRIL 21–24: National Committee of URSI-IRE, National Bureau of Standards, Washington, D. C.
MAY 2–3: Association for Computing Machinery, Pittsburgh, Pa.
MAY 5–7: Second Government-Industry Conference, sponsored by RTMA, NEMA, AIEE, at National Bureau of Standards, Washington, D. C.
MAY 5–16: British Industries Fair, Earls Court and Olympia, London, England, and Castle Bromwich, Birmingham, England.
MAY 12–14: National Conference on Airborne Electronics, Biltmore Hotel, Dayton, Ohio.
MAY 13: RADIO CLUB of America, Room 502, Engineering Societies Building, New York, N. Y.
MAY 16–17: Fourth Southwest IRE Conference and Radio Engineering Show, Rice Hotel, Houston, Tex.
MAY 19–22: 1952 Electronics Parts Shows, Exhibition Hall, Stevens Hotel, Chicago, Ill.
MAY 22–24: Electronics Section, Quality Control Convention, Syracuse, N. Y.
MAY 23–24: 1952 Audio Fair, Conrad Hilton Hotel, Chicago.
JUNE 8–12: National Association Electrical Distributors, Ambassador Hotel, Atlantic City, N. J.
JUNE 23–27: AIEE Summer General Meeting, Hotel Nicole, Minneapolis, Minn.
AUG. 12–15: 1952 APCO Conference, Hotel Whitcomb, San Francisco, Calif.
AUG. 27–29: Western Electronic Show and Conference, Municipal Auditorium, Long Beach, Calif.
SEPT. 8–12: National Instrument Conference and Exhibit, Cleveland, Ohio.
OCT. 20–22: Radio Fall Meeting, RTMA Engineering Department, Hotel Syracuse, Syracuse, N. Y.
NOV. 10–30: International Radio and Electronics Exhibition, Bombay, India.

Business Briefs

► **A Ceramic** permanent magnet has been developed in the Netherlands by Philips Research Laboratories. This chinaware-like product needs no cobalt or nickel, contains barium.

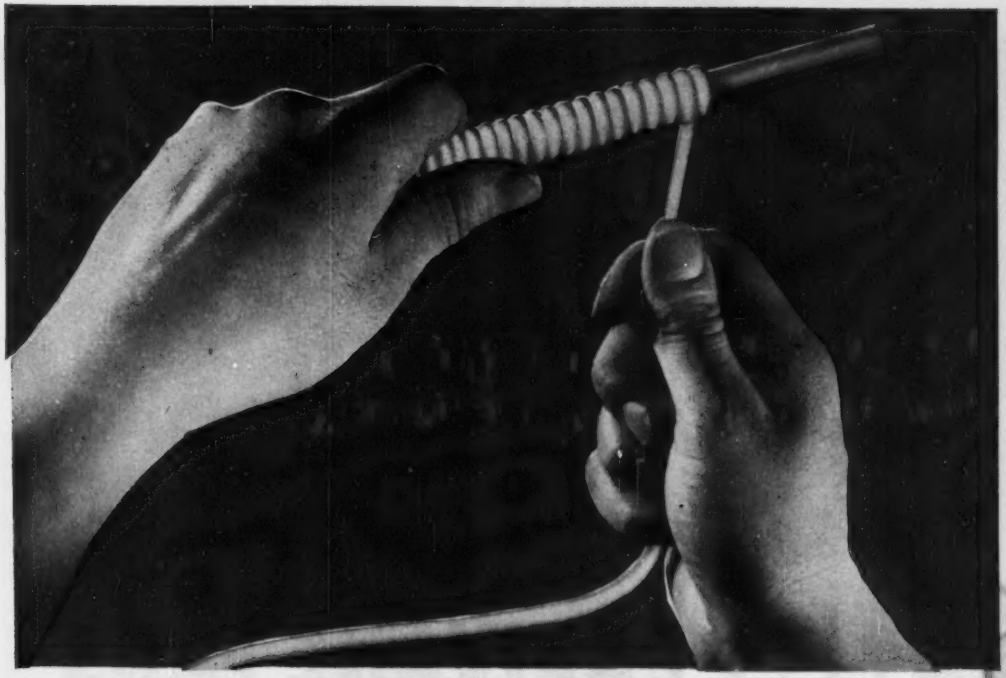
► **TV Sales** by areas are tabulated and distributed by RTMA. Statistical Committee chairman Frank Mansfield says that the breakdown by areas will soon be extended to cover radio sets. First breakdown will cover all of 1951.

► **Australia** has started stockpiling electronic equipment. The Aussies are placing orders abroad for recording and insulation-measuring equipment because local production cannot produce enough for anticipated needs. The government is encouraging big world firms to come 'down under' to manufacture much-needed radar equipment.

► **Airplane Makers** are spending more money on electronic equipment these days than on airframes and power plants combined, according to H. Leslie Hoffman of Hoffman Radio.

► **Major League** baseball clubs received, in dollars and cents, over $4 million for radio-tv rights in 1951, reports the Radio-Television Manufacturers Association.

► **Cross-Channel** microwave tv link may be set up between France and England if plans for celebration of the French national holiday on July 14 go through. Temporary or permanent, a link would provide a fillip to tv equipment business.



Now . . . an extremely flexible high-temperature tubing . . . IRVINGTON Silicone Rubber-Coated Fiberglas*

If you need a *flexible* insulating tubing that meets Class "H" specifications—and particularly if you need it *now*—look into this new Irvington product!

With the introduction of Silicone *Rubber*-Coated Fiberglas Tubing, Irvington offers to the electrical industry a product that, like the resin-coated type, meets all NEMA Class "H" requirements. In addition, this new tubing has the advantage of extreme flexibility. Its white color is a plus wherever appearance is a factor.

AND . . . Irvington Silicone Rubber-Coated Fiberglas Tubing is available for immediate delivery!

Get the full story—just mail the coupon for technical data sheet.

*T.M. Reg. U. S. Pat. Off. by Owens-Corning Fiberglas Corp.

Send this convenient coupon now

Irvington

VARNISH & INSULATOR COMPANY

Irvington 11, New Jersey

Plants: Irvington, N. J.; El Monte, Calif.; Hamilton, Ontario, Canada

EL 3/52

Irvington Varnish & Insulator Co.
Argyle Terrace, Irvington 11, N. J.

Gentlemen:
Please send me technical data sheet on Irvington Silicone Rubber-Coated Fiberglas Insulating Tubing.

Name.....Title.....

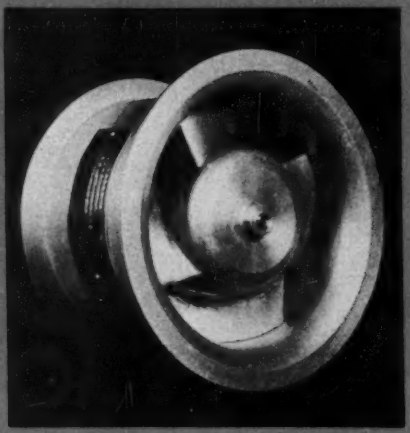
Company.....

Street.....

City.....Zone.....State.....

For Further Information, Consult pages 92-93 in the 1951-1952 Electronics Buyers' Guide

From VERY SMALL ... to LARGE CAPACITY



JOY AXIVANE® FANS

are available to meet any ELECTRONIC COOLING NEED

Joy AXIVANE Electronic Cooling Fans are expressly designed to meet the needs of this exacting field of service. They are built in a complete range to suit any requirements, such as: spot cooling of ventilated units where local high-temperature conditions arise; heat removal from pressurized or hermetically-sealed units; or heat removal where space is so restricted that natural ventilation through the unit or over its surface is insufficient. Important operating advantages of these fans are their strength, high resistance to shock and vibration, and efficiency in low or high-pressure service. Aluminum and magnesium construction keeps weight at a minimum.

Available in sizes from 2" I.D. up, these Joy Fans are built to meet all present Air Force and Naval electronic specifications. They can be furnished with totally enclosed or explosion-proof motors, if desired.

In general, keep these facts in mind: that the light, compact design, low power consumption and high overall efficiency of Joy AXIVANE Fans provide more satisfactory cooling for electronic equipment in either air-borne or surface units. ● If you have a problem in heat dissipation from electronic units, let us place at your disposal JOY's experience as the world's largest manufacturer of vaneaxial-type fans.

Consult a Joy Engineer

Over 100 Years of Engineering Leadership

WBD 1 4064

JOY MANUFACTURING COMPANY

GENERAL OFFICES: HENRY W. OLIVER BUILDING · PITTSBURGH 22, PA.

IN CANADA: JOY MANUFACTURING COMPANY (CANADA) LIMITED, GALT, ONTARIO

Announcing and introducing the new Airpax MIDGET Chopper
On display for first time at IRE Show, Booth 477. Don't Miss It!

NOW AIRPAX BRINGS YOU THE NEWEST, MOST REVOLUTIONARY DEVELOPMENT IN CHOPPERS!

Here's the biggest, most important news in choppers the industry has ever seen. It's the new Airpax MIDGET . . . being introduced now for the first time after three years of intensive engineering development work. Compare the exclusive features of the MIDGET with choppers you're now using. You'll specify Airpax MIDGETS from now on.

MODEL NO. C747

the AIRPAX MIDGET

DIMENSIONS Weight—33.6 grams (.074 lbs.) Size—Fits 7 pin miniature socket Length 1.812 Maximum diameter .791	**SPECIFICATIONS** Meets An-E-19 specifications. See Airpax specification 156 for details of operation.	**CONTACTS** Single pole double throw only, break before make. Rated at 100 volts, 2 ma.	**VIBRATION** Operates well under vibration of 10G, 10 to 55 cycles.
DRIVE At present available only at 400 cycles, 6.3 volts, with maximum coil voltage of 6.3. (Usual frequency range is 380 to 420 cycles.)	**PHASE ANGLE** Contacts lag 65° behind a driving sine wave. Dwell time approximately 135° per side.	**TEMPERATURE** Operates successfully between −70C to 100°C. Will not be damaged by temperatures varying over those limits.	**ACCELERATION** Will operate under greater than 50G, any plane. Will take over 500G, in certain planes.
RESIDUAL NOISE At 1 megohm impedance, residual noise is less than 400 microvolts peak, measured from any contact to ground.	**HERMETIC SEALING** May be operated at full rating at any altitude or humidity. Will not be damaged by prolonged exposure to either humidity or salt spray.		**LIFE** Repeated life tests by some of nation's major electronic and aircraft concerns show a life expectancy in excess of 1,000 hours.

AIRPAX
DESIGNERS PRODUCTS COMPANY ENGINEERS

MIDDLE RIVER, BALTIMORE 20, MD.

FIRST . . . with the finest in CHOPPERS, VIBRATORS, INVERTERS, TRANSFORMERS & POWER SUPPLIES

CHATHAM
ELECTRONIC TUBES

Hydrogen Thyratrons
—for Pulse Voltage Generation

ELECTRICAL DATA*				
Type	VC-1258	5949/1907	5948/1754	VC-1257
Maximum Peak Forward Anode Potential	1000 volts	25000 volts	25000 volts	38000 volts
Maximum Peak Anode Current	20 amps	500 amps	1000 amps	2000 amps
Maximum Average Anode Current	0.05 amps	0.50 amps	1.0 amps	2.0 amps
Maximum Heating Factor (epy x prr x ib)	1.0×10^8	6.25×10^9	9.0×10^9	—
Nominal Filament Power	12.6 watts	95 watts	190 watts	330 watts
Hydrogen Reservoir	No	Yes	Yes	Yes

*More detailed information on electrical and mechanical data will be supplied on request.

TYPE VC-1257
Hydrogen filled, zero bias thyratron with hydrogen generator for generation of pulse power up to 40 megawatts.

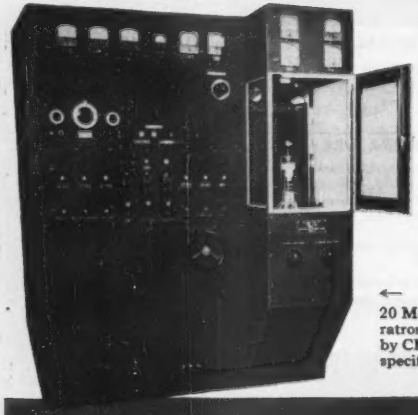
TYPE 5948/1754
Hydrogen filled, zero bias thyratron with hydrogen reservoir for generation of peak pulse power up to 12.5 megawatts.

TYPE 5949/1907
Hydrogen filled, zero bias thyratron with hydrogen reservoir for generation of peak pulse power up to 6.25 megawatts.

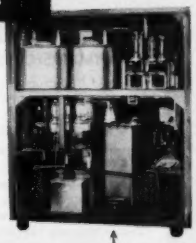
TYPE VC-1258
Zero bias miniature hydrogen thyratron for the generation of peak pulse power up to 10 KW.

• **A NEW CONCEPT OF HYDROGEN THYRATRON DESIGN!** The tubes illustrated represent a departure from conventional hydrogen thyratron designs and are a result of several years of concentrated development work. They are primarily employed in the generation of peak voltages with durations in the order of microseconds.

Custom-built Electronic Equipment

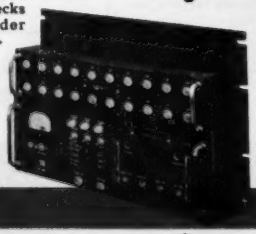


• **CHATHAM specializes in the development, design, and construction of custom-built electronic equipment to exactly meet customers' requirements. Our capable staff of engineers will furnish prompt estimates or, if desired, will call to discuss your problem personally. Call or write today.**



5 Megawatt radar modulator built by CHATHAM to rigid government standards.

Pulse life test equipment built by CHATHAM checks receiver type tubes under pulse conditions. →



← 20 Megawatt Hydrogen Thyratron Test Equipment built by CHATHAM to customers' specifications.

ELECTRONICS AND EQUIPMENT

Electronic Tubes

Ruggedized Type Tubes

• The following tubes are JAN approved and can be supplied promptly, usually direct from stock:

5R4WGY	2D21W
6AL5W	OC3W
6H6WGT	OD3W
25Z6WGT	2050W

TYPE 719-A HIGH VACUUM CLIPPER DIODE

This tube is used primarily for clipper diode service in hard tube modulator circuits. Filament 7 volts, 7 amps... Inverse peak anode voltage 25 kv, Max., peak anode current 10 amps, Max., anode dissipation 75 watts.

TYPE 1Z2 RECTIFIER

A small bulb high voltage vacuum rectifier. Low cathode heating power and low dielectric losses make tube suitable for radio frequency supply circuits. Filament 1.5 volts, .290 amps... Inverse peak anode voltage 20,000, average plate current 2 ma.... peak plate current 10 ma.

TYPE 1B46 REGULATOR

A cold cathode glow discharge tube designed for voltage stability. DC operating voltage 82 volts, operating current range 1 ma minimum, 2 ma maximum. Regulation 3 volts.

TYPE 395-A COLD CATHODE GAS TRIODE

Requires no filament supply and is used in many grid controlled rectifier and relay applications. Maximum D.C. anode current—10 ma. Maximum D.C. anode voltage—150 volts

TYPE 4B32 RECTIFIER

A rugged half-wave Xenon filled rectifier. Operates in any position throughout an ambient temperature range of −75°C to +90°C. Filament 5 volts, 7.5 amp... Inverse peak anode voltage 10,000, average anode current 1.25 amp.

TYPE 394-A THYRATRON

A Mercury vapor and Argon filled thyratron for grid controlled rectifier service. Operates over wide ambient temperature range. Heater 2.5 volts, 3.2 amps... Inverse peak anode voltage 1250, average anode current 840 ma.

TYPE 3B28 RECTIFIER

This rugged half-wave Xenon filled rectifier will operate in any position and throughout an ambient temperature range of −75°C to +90°C. Filament 2.5 volts, 5.0 amps... Inverse peak plate voltage 10,000, average anode current .25 amp.

Chatham Vacuum Switches

● TYPE 1S22 (illustrated) is a mechanically actuated, single-pole, double-throw, glass vacuum switch. This and other types can be supplied.

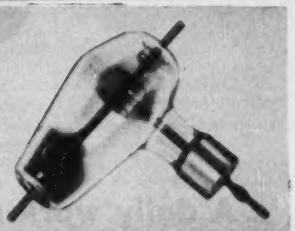
SPECIFICATIONS

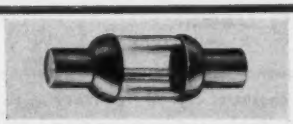
HOLD OFF VOLTAGE: Internal—10,000 volts rms; External* (at 27,000 feet altitude)—10,000 volts rms; External* (at 40,000 feet altitude)—7,500 volts rms.

INTERRUPTING RATING, RESISTIVE LOAD: 1,000 operations life at 10,000 v, ac, rms—10 amp, ac, rms; 1,000,000 operations life at 10,000 v, ac, rms—2 amp, ac, rms; 500,000,000 operations life at 10,000 v, ac, rms—0.1 amp, ac, rms.

NET WEIGHT (approx.)	½ ozs.	MAXIMUM WIDTH (overall)	4½ ins.
MAXIMUM LENGTH (overall)	3⅜ ins.	MAXIMUM THICK. (overall)	1¼ ins.

*at 50% humidity





HIGH VOLTAGE VACUUM FUSES

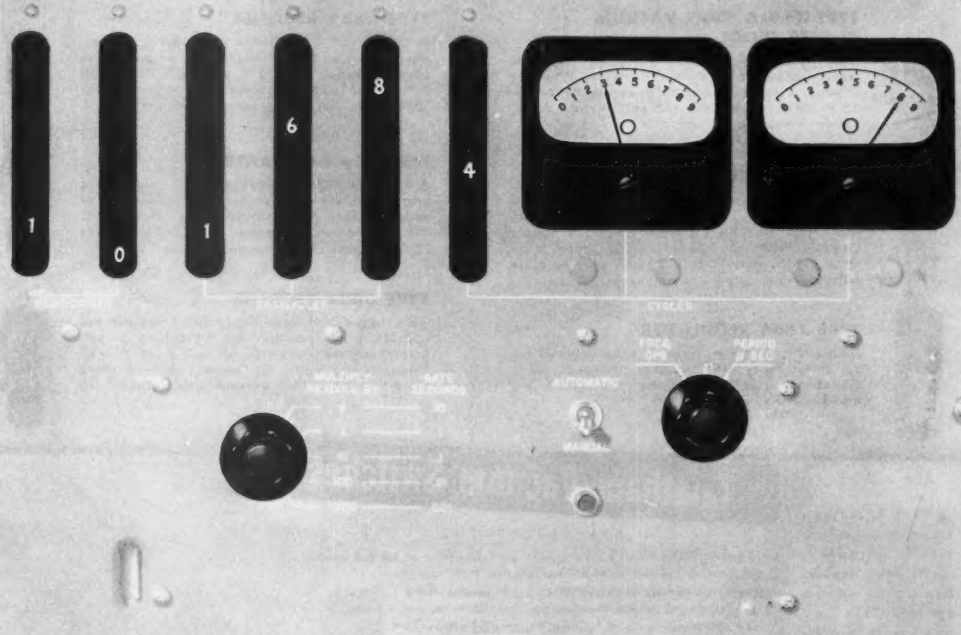
Can be supplied by Chatham to exact customers' specifications if ordered in adequate quantity. Call or write for full particulars and quotes.

CHATHAM ELECTRONICS • INC.

475 WASHINGTON STREET • NEWARK 2, NEW JERSEY

With this one *NEW* instrument read frequency directly, automatically, without calculation—*in 1 second or less!*

Any frequency to 10,000,000 cps displayed here the split-second unknown is connected! No other equipment needed, no interpolation. (Frequency counted below, 10,168,438 cps.)



A daily work-saver for laboratory or production line! Here are just a few time-saving uses!

- Measure exact frequency of transmitters and crystal oscillators
- Calibrate sub-audio, audio and supersonic test oscillators
- Measure rpm electronically up to 600,000,000 rpm
- Establish frequencies for filter characteristic determination
- Monitor frequency drift with precise accuracy
- Make rapid checks of crystal frequency
- Read total random events per unit time
- Use as precision frequency standard

HEWLETT-PACKARD *hp* INSTRUMENTS

REVOLUTIONARY NEW
-hp- 524A FREQUENCY COUNTER

- **No figures to add, no calculations!**
- **No complex equipment set-up!**
- **Easily used by non-technical personnel!**
- **Production-line speed, instantaneous readings!**
- **Laboratory accuracy, 1/1,000,000 ±1 count!**
- **Broad coverage, .01 to 10,000,000 cps!**

-hp- 524A Frequency Counter sets new standards for accurate, high-speed frequency measurement in the laboratory or on the production line. It counts frequency instantly, automatically, without effort on your part. It performs all functions of a frequency standard, interpolating system, and detector. For frequency determination it eliminates expensive, hard-to-maintain harmonic amplifiers, transfer oscillators, multi-vibrators, and oscilloscopes.

BRIEF SPECIFICATIONS

-hp- 524A Frequency Counter

COUNTING RATE: 10 mc maximum.

PRESENTATION: 8 places, direct reading.

COUNT PERIOD: 0.001, 0.01, 0.1, 1, 10 secs.

LOW FREQUENCIES: Permits low frequencies to operate as time base. Duration of one cycle is displayed in microseconds.

ACCURACY: ± 1 count ± 2/1,000,000 per week. (Higher accuracy external standard may be employed.)

PERIOD MEASUREMENT: Within 0.03% up to 300 cps: within 1 μsec between 300 cps and 10 kc.

EXTERNAL 100 KC TIMING CIRCUIT: For higher accuracy. Requires 1 v across 50,000 ohms shunted by 30 μμfd.

INPUT VOLTAGE: 1 v peak minimum.

INPUT IMPEDANCE: Approx. 100,000 ohms, 30 μμfd shunt.

CONNECTORS: Standard BNC type.

POWER SOURCE: 115 v, 50/60 cps, 400 watts.

SIZE: Approx. 28" high, 21¾" wide, 14" deep. Weight 115 lbs. Shipping weight 175 lbs.

PRICE: $2,000.00 f.o.b. factory.

Data Subject to Change Without Notice

Two Types of Measurement

1. Direct Counting for High Frequencies • The equipment counts and displays—*directly*—unknown frequencies over exact time intervals of 10, 1, 0.1, 0.01, and 0.001 seconds. Counting and display periods are equal and automatically cycled. The count is displayed repetitively; or, by merely pressing the "manual" button, can be "held" any length of time.

2. Period Measurement for Low Frequencies • The equipment measures the duration of one low frequency cycle in microseconds. A 10 cps sample is taken to determine this period. Periods may be displayed repetitively or "held" as in frequency counting.

Circuit Description

-hp- 524A operates on pulse counting techniques. The unknown is applied through a wide-band squaring amplifier to a fast gate controlled by a time base generator. When the gate is open, unknown is applied to counting circuits. When gate is closed, counting circuits remember and display the counted frequency in cps, or the period in microseconds. Time base circuits are controlled by a highly stable crystal oscillator with instantaneous stability of 1/1,000,000; accuracy of 2/1,000,000 per week.

New -hp- 520A High-Speed Scaler

This new *-hp-* equipment is an aperiodic 10 mc scaler offering precise accuracy and high-speed operation for easy measurement of "fast" circuits and nuclear parameters. This equipment is built into *-hp-* 524A Frequency Counter, and is also available as a separate instrument.

-hp- 520A Scaler will count period pulses from 0 cps to 10 mc. Double-pulse resolving time is 0.1 μsec. Triple-pulse resolving time is 0.2 μsec. Scaler delivers 1 output pulse per 100 received, and displays residual count on two panel meters. Instrument may be used with conventional 10^8 pps scalers to increase count capacity. $600.00 f.o.b. factory.

See your -hp- field engineer or write direct for complete details.

HEWLETT-PACKARD COMPANY

2322A PAGE MILL ROAD • PALO ALTO, CALIFORNIA, U.S.A.

Export: Frazar & Hansen, Ltd., San Francisco, Los Angeles, New York

Westinghouse Switchboard Instruments are used as "standards" on this Universal Tube Test Station manufactured by Radio Corporation of America.

Westinghouse Switchboard Instruments are available in circular or conventional scale types for any switchboard application.

Where instrument accuracy is a "Must"... specify Westinghouse

The use of Westinghouse instruments as "standards" on RCA's Master Tube Test Stations demonstrates how they measure up to *your* need for accurate measurement of any electrical quantity.

In order to reliably measure the quality of all types of electronic tubes the instruments have to consistently maintain precise accuracy. Westinghouse Switchboard Instruments not only fulfill this requirement but provide important plus benefits as well: Easier readability—to simplify the operator's job . . . and co-ordinated space-saving design—to contribute to the functional compactness of the unit.

Here's further assurance of quality: all Westinghouse switchboard panel, portable and recording instruments are built to meet the rigid performance requirements of the American Standards Association. Moreover, you can select from . . .

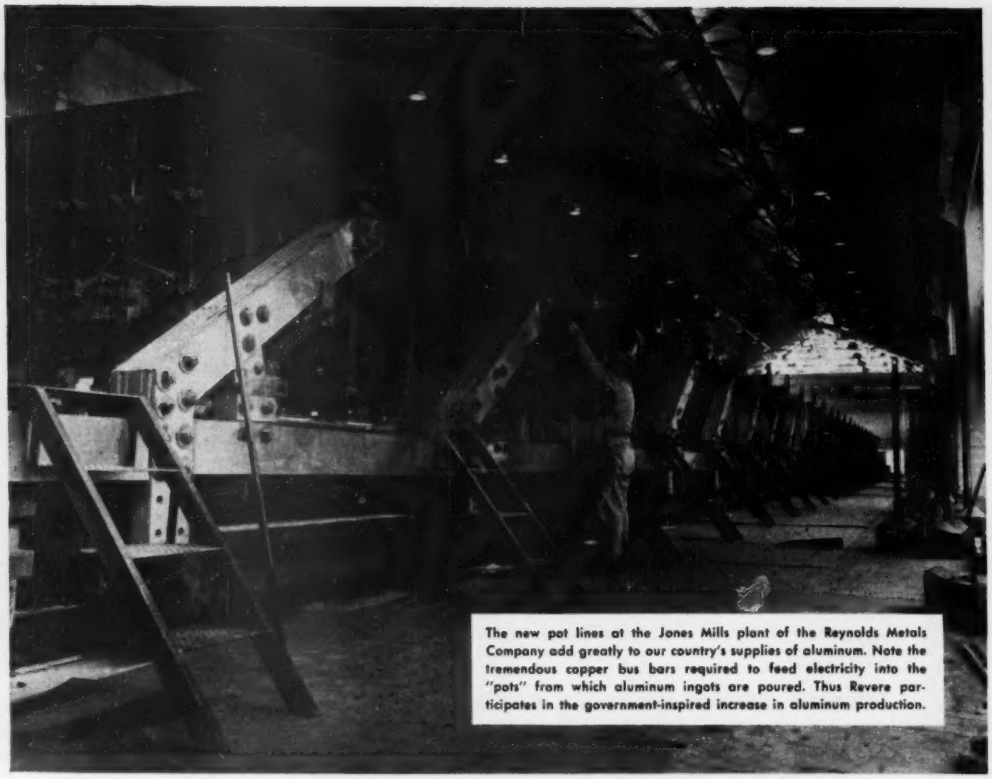
The most complete line in the industry!

You get a wider selection for every need whether it be a-c or d-c current and voltage, single or polyphase circuits, watts or vars, frequency, power factor, synchroscopes, temperature indicators, ground detectors or synchrotie (position indicators). And you get . . .

Competent application assistance!

Westinghouse Instrument Application Engineers are available to consult with and serve you in selecting and applying the proper instruments for your application. Simply call your nearest Westinghouse office.

For complete information about Westinghouse Instruments write for Booklet B-4696. Address: Westinghouse Electric Corporation, P.O. Box No. 868, Pittsburgh 30, Pennsylvania. J-40400



The new pot lines at the Jones Mills plant of the Reynolds Metals Company add greatly to our country's supplies of aluminum. Note the tremendous copper bus bars required to feed electricity into the "pots" from which aluminum ingots are poured. Thus Revere participates in the government-inspired increase in aluminum production.

It takes a lot of REVERE COPPER BUS BAR to increase aluminum production

● The Government has directed Revere to produce millions of pounds of copper bus bar for the new aluminum plants being put into operation in order to increase the output of this light metal that is so essential to defense. Copper is the ideal metal to carry the heavy currents required for the "pots" that produce aluminum from the ore. Thus aluminum and copper are intimately linked together. Aluminum is used in planes, ships, weapons, missiles, ammunition, and in many other defense applications. Copper, best of all the commercial metals in electrical conductivity, likewise has many vital tasks to perform for our armed forces, afloat, ashore, and in the air.

Revere is glad that its large capacity for the production of bus bar is so valuable in these times; in our long history of over 150 years of service we have always given everything possible in times of our country's need. However, we are regretful that today's government requirements materially limit our ability to fill civilian orders. We look ahead, eagerly and hopefully, to the time when the present urgent demands are met to such an extent that orders for bus bar and other Revere products can be filled more promptly.

REVERE

COPPER AND BRASS INCORPORATED

Founded by Paul Revere in 1801

230 Park Avenue, New York 17, New York

• • •

Mills: Baltimore, Md.; Chicago and Clinton, Ill.; Detroit, Mich.; Los Angeles and Riverside, Calif.; New Bedford, Mass.; Rome, N. Y. Sales Offices in Principal Cities, Distributors Everywhere.

SEE "MEET THE PRESS" ON NBC TELEVISION EVERY SUNDAY

HENRY ...FIRST to produce an Electric Motor

Joseph Henry
1797-1878

This great American physicist discovered many of the basic principles and applications of electromagnetism. His "philosophical toy," which transformed electromagnetic energy into mechanical motion, was actually the first d-c electric motor. He also laid the groundwork for development of the telegraph, telephone, and wireless, and is credited with the discovery of magnetic self-induction. The *henry*, unit of inductance, is named for him.

From an original drawing made for OHMITE.

OHMITE® ...FIRST in Resistors ...today

Be Right with

OHMITE
RHEOSTATS
RESISTORS
TAP SWITCHES

Ohmite wire-wound resistors are recognized and preferred all over the world for their *dependability*—their ability to provide long life and reliable performance under the most adverse operating conditions. Furthermore, Ohmite offers the most complete line of wire-wound resistors on the market today, with types and sizes for every need. Where *extra* dependability counts, specify Ohmite resistors—overwhelmingly industry's first choice.

OHMITE JAN-TYPE WIRE-WOUND RESISTORS

MEET REQUIREMENTS OF JOINT ARMY-NAVY SPECIFICATION JAN-R-26A

STYLES AND SIZES

TAB-TERMINAL TYPE

Characteristics G and J

Style	Overall length	Diameter	*Watts
RW-29	1-3/4"	1/2"	6
RW-30	1"	19/32"	8
RW-31	1-1/2"	19/32"	10
RW-32	2"	19/32"	12
RW-33	3"	19/32"	18
RW-34	3"	29/32"	30
RW-35	4"	29/32"	38
RW-36	4"	1-5/16"	60
RW-37	6"	1-5/16"	78
RW-38	8"	1-5/16"	110
RW-39	12"	1-5/16"	166

TAB-TERMINAL TYPE with terminal hole to clear No. 8 screw

Characteristics G and J

Style	Overall length	Diameter	*Watts
RW-40	3"	29/32"	24
RW-41	4"	29/32"	32
RW-42	4"	1-5/16"	49
RW-43	6"	1-5/16"	74
RW-44	8"	1-5/16"	100
RW-45	12"	1-5/16"	160
RW-46	10-1/2"	1-5/16"	135
RW-47	10-1/2"	1-9/16"	145

FERRULE-TERMINAL TYPE

Characteristics G and J

Style	Overall length	Diameter	*Watts
RW-10	11-7/16"	1-5/16"	140
RW-11	9-5/8"	1-5/16"	116
RW-12	7-7/16"	1-5/16"	86
RW-13	5-1/8"	1-1/16"	50
RW-14	4-7/16"	1-1/16"	40
RW-15	2-15/16"	3/4"	20
RW-16	2-3/8"	3/4"	14

FLAT (Stack Mounting) TAB-TERMINAL TYPE

Characteristics G and J

Style	Overall length	Width of Core	Thickness of Core	*Watts
RW-20	2-1/2"	1-3/16"	1/4"	15
RW-21	3-1/4"	1-3/16"	1/4"	22
RW-22	4-3/4"	1-3/16"	1/4"	37
RW-23	6"	1-3/16"	1/4"	47
RW-24	7-1/4"	1-3/16"	1/4"	63

*Watts free air JAN Characteristic "G"

AXIAL-TERMINAL TYPE

Characteristics G and J

Style	Length of Core**	Diameter	*Watts
RW-55	1-3/8"	5/8"	5
RW-56	2"	5/8"	10

**2-1/2" wire leads

Ohmite offers an unusually complete line of resistors that meet the most rigid requirements (Characteristics "G" and "J") of Joint Army-Navy Specification JAN-R-26A. To meet these requirements, resistors must pass severe moisture resistance and thermal shock tests. They are required to withstand strenuous vibration applied for five continuous hours. And, they must satisfy the requirements of many other tests, including momentary overload, mechanical strength, and terminal strength.

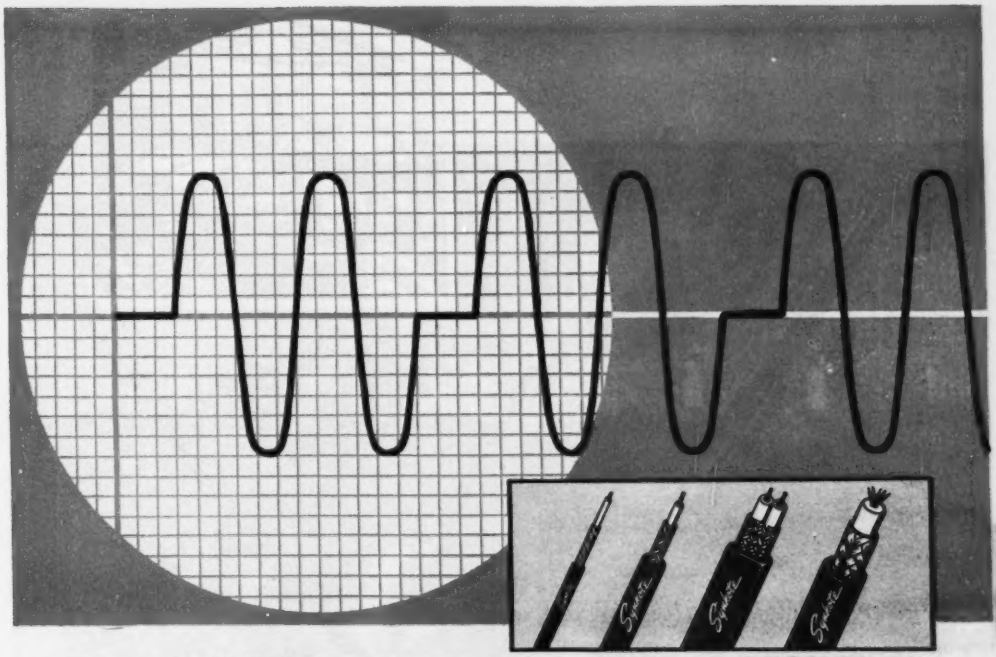
Of the 38 different resistor styles listed in JAN-R-26A, Ohmite offers 33 styles that meet these specifications. These styles represent the most popular resistors, and are available in a complete range of resistance values, in the types and sizes listed.

OHMITE MANUFACTURING COMPANY
4817 Flournoy St., Chicago 44, Ill.

Be Right with...

OHMITE®

RHEOSTATS • RESISTORS • TAP SWITCHES



Several Things Less to Worry About... When You Specify Synkote Coax Cable

Attenuation, impedance, shielding, insulation, velocity of propagation, *all* the worrisome wire factors affecting your final signal are *dependably constant* in SYNKOTE Coaxial Cables.

Manufactured to 10 standard specifications, SYNKOTE Coax Cables are available in impedances from 50 to 300 ohms . . . insure minimum attenuation and maximum dependability at all frequencies and under most conditions.

For specifications other than standard, our engineering service department will be glad to work with you. Write today — your inquiry will be given prompt attention.

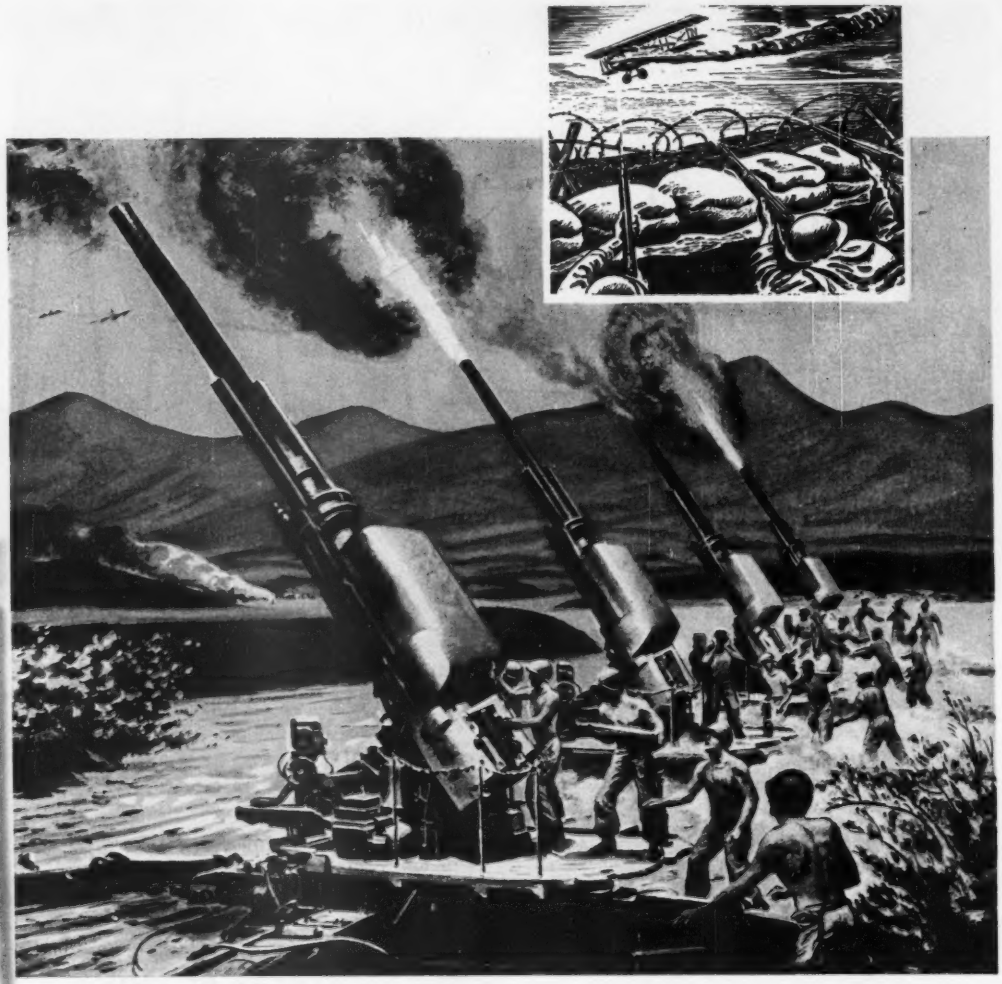
Synkote

DEPENDABLE
Coaxial Cable
"Made by the mile — tested by the inch"

● *You are cordially invited to visit us at BOOTH #451 (Lexington Avenue and 46th St. corner), Grand Central Palace, March 3, 4, 5, 6*

PLASTOID CORPORATION
42-61 24th STREET, LONG ISLAND CITY 1, NEW YORK

HOOK-UP WIRE • AIRCRAFT CABLE • TV WIRE • COAXIAL CABLE • NYLON JACKETING • HIGH TEMPERATURE WIRE • MULTI-CONDUCTOR CABLES



Electronics puts real sting in modern ground defenses

Today's high-level, high-speed aerial attack imposes ever-increasing burdens on ground defenses. Only electronics can supply the split-second action now demanded for effective antiaircraft gunnery. During thirty-three years of collaboration with our Armed Forces, Arma has developed the matchless research and engineering skills required to design, improve and produce many of the complex instruments that keep our naval, military and aerial weapons abreast of constantly changing target problems.

ARMA CORPORATION
254 36th Street, Brooklyn 32, N.Y.
SUBSIDIARY OF AMERICAN BOSCH CORPORATION

QUALITY ARMA INSTRUMENT PRECISION

HIVOLT POWER SUPPLIES—

deliver high voltage at low currents . . .

HIVOLT POWER SUPPLIES are hermetically sealed, self-contained units. Their small size, ease of operation and flexibility are ideal for the operation of display tubes, radiation counters, photoflash devices, electrostatic precipitators, insulation testers, spectrographic analyzers and other equipment.

400 CYCLE POWER SUPPLIES

Power supplies using a primary source voltage with frequencies of 400 or more are also available or can be made to suit your requirements.

The following standard power supplies are designed for 60 cycle, 117 volt operation:

PS-50*—50 KV; 2 ma output; size of case: 12½" x 12½" x 12½" high

PS-30*—30 KV; 1 ma output; size of case: 7" x 7" x 8"

PS-15*—15 KV; 1 ma output; size of case: 3¾" x 4-9/16" x 9"

PS-10*—10 KV; 1.5 ma output; size of case: 3¾" x 4-9/16" x 8"

PS-5 —5 KV; 3 ma output; size of case: 3¾" x 4-9/16" x 6"

PS-2 —2 KV; 2 ma output; size of case: 3¾" x 3-3/16" x 5½"

* Can be used with a primary voltage control device for adjustment to output voltage values from 0 to rated voltage.

We invite your inquiries.

• • •

Our specialty is engineering capacitors to exacting requirements.

MANUFACTURERS
Glassmike Capacitors
Plasticon Capacitors
HiVolt Power Supplies
Pulse Forming Networks

All Phones: **AMbassador 2-3727**

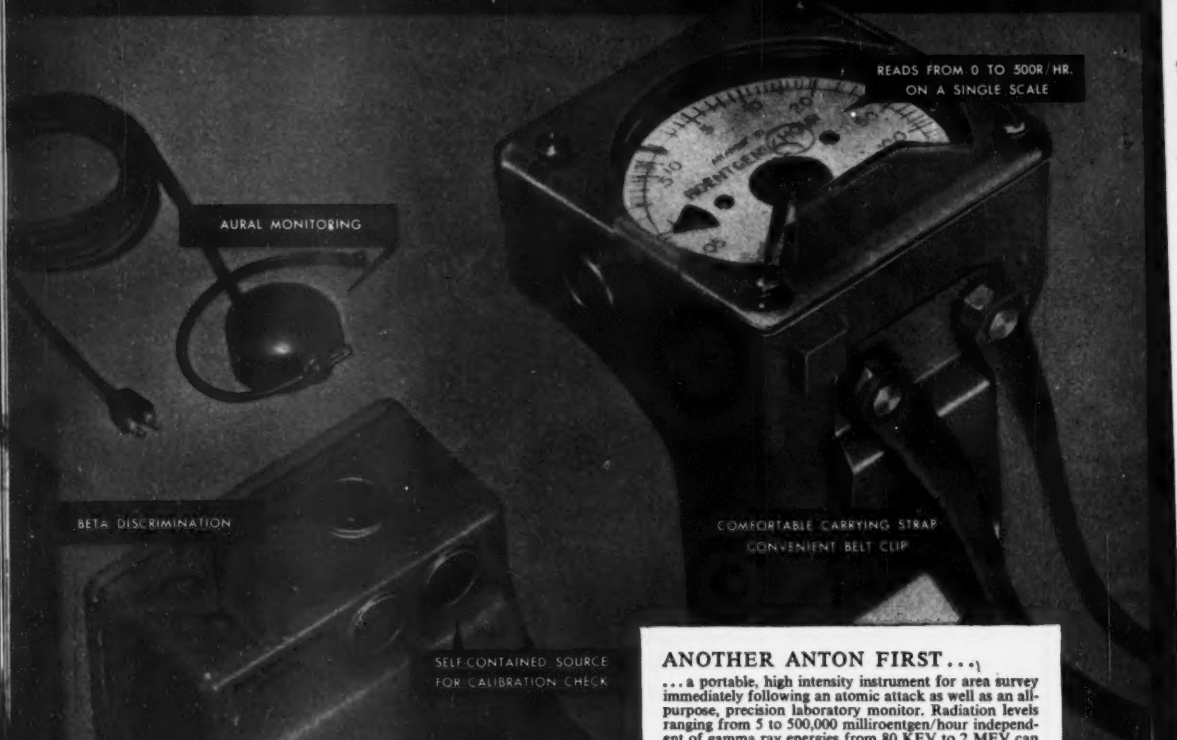
Condenser Products Company

7517 North Clark Street • Chicago 26, Illinois

The HIGH INTENSITY RADIOLOGICAL MONITORING INSTRUMENT

conceived and developed by

ANTON ELECTRONIC LABORATORIES for the U.S. NAVY


READS FROM 0 TO 500R/HR. ON A SINGLE SCALE
AURAL MONITORING
BETA DISCRIMINATION
COMFORTABLE CARRYING STRAP
CONVENIENT BELT CLIP
SELF-CONTAINED SOURCE FOR CALIBRATION CHECK
POWERED BY ONLY TWO FLASHLIGHT BATTERIES
OPERABLE FROM REMOTE POWER SOURCE TOO

ANOTHER ANTON FIRST...

...a portable, high intensity instrument for area survey immediately following an atomic attack as well as an all-purpose, precision laboratory monitor. Radiation levels ranging from 5 to 500,000 milliroentgen/hour independent of gamma ray energies from 80 KEV to 2 MEV can be determined accurately on its single six inch long scale.

The instrument is the culmination of years of fundamental research at AEL which has resulted in the development of entirely new integrator tubes – variable voltage corona regulator tubes – a high efficiency vibrator supply – new electronic circuits – uniquely miniaturized components.

This military instrument incorporates new features originally required by the Bureau of Ships and subsequently requested by other government agencies – beta discrimination... integral calibration check with radioactive source... operation from two 1½ volt flashlight batteries... no hot cathode tubes... aural monitoring... operating temperature range −52°C to +85°C... illuminated dial... 2 pound total weight... complete portability with belt clip and adjustable carrying strap... compact.

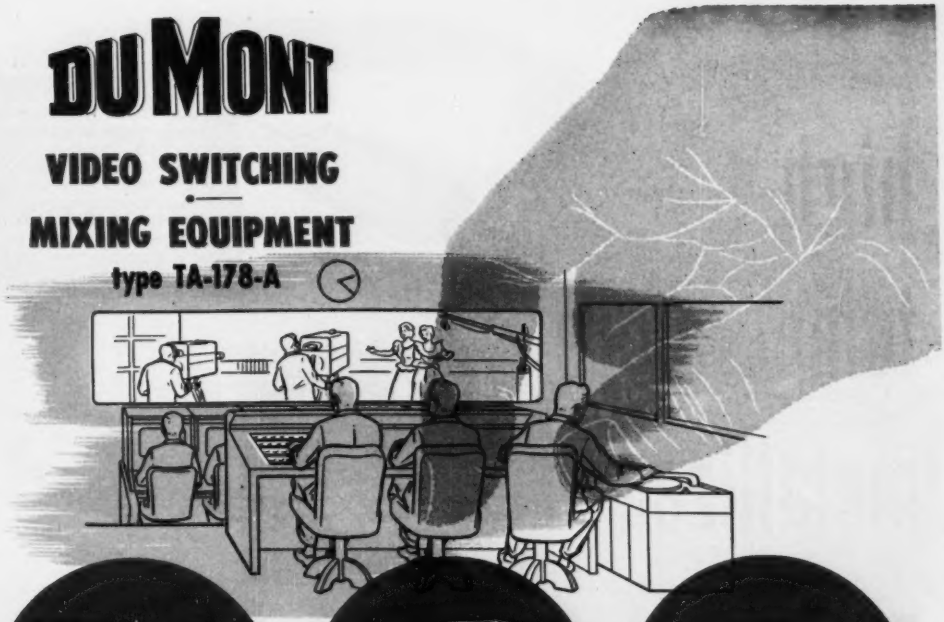
Although AEL is working full speed ahead for the U.S. Navy right now, we do expect additional production to make the general release of our Radiological Monitoring Instrument possible soon.

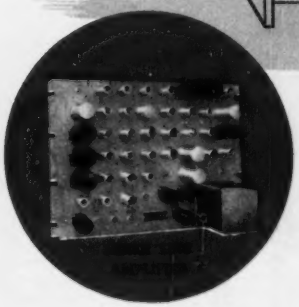
ANTON ELECTRONIC LABORATORIES, INC.

126-12

DUMONT

VIDEO SWITCHING
MIXING EQUIPMENT
type TA-178-A





SIMPLIFIED FINGER-TIP CONTROL FOR VIDEO SWITCHING

Comprising the Nine-Channel Switch Unit (5262-A), Mixer Line Amplifier (5263-A) and Low Voltage supply (5019-A).

Variety of special effects, achieved quite simply with the provisions in the Mixer Amplifier, can be previewed before being put on the air. Single Mixer Control at Switching unit permits smooth transition from one channel to another. Again, another control at Switch Unit determines bus cutoff voltage cross-over point, so that any degree of fading, lapping or superimposing of two signals an be accomplished. Provision is made available in the Mixer Amplifier for insertion of special blanking to create special effects such as wipes, montages, etc.

While main line is feeding transmitter, the mixer amplifier output can be used to feed, simultaneously, a different mixed studio show to an audition circuit. The Mixer Amplifier has three identical program outputs which may be fed to transmitter, network cable and master line monitor.

First with the Finest in Television

TELEVISION TRANSMITTER DIVISION
ALLEN B. DU MONT LABORATORIES, INC.
1500 Main Avenue, Clifton, N. J.

FEATURES

Switch Unit available for mounting in standard 19" relay rack or in console. Mixer Line Amplifier and its power supply are rack-mounted.

All channels take either local or remote signals.

Lap, fade or super are achieved with single control. Facilities for inserting special blanking (horizontal wipes, montages, etc.). Preview for special effects.

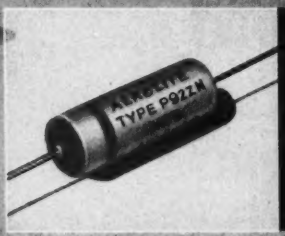
Sync insertion on local signals, controlled by pushbuttons. No switching transients on main-line switching. Automatic pedestal setup incorporated in mixer amplifier.

Frequency response of preview monitor No. 1 amplifier, mixer amplifier and main-line amplifier flat within 0.5 db to 8 MC; less than 6 db down at 10 MC. Preview Monitor No. 2 amplifier flat with in 0.5 db to 6 MC; less than 6 db down at 8 MC.

Lucite, pushbuttons lighted internally when button is pressed.

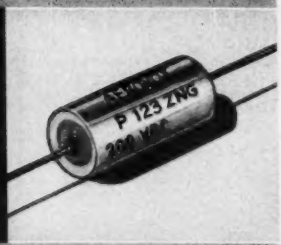
FURTHER DETAILS and QUOTATIONS ON REQUEST

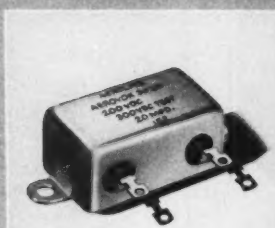
high-temperature metallized-paper capacitors



Series P92ZN Aerolene-impregnated metallized-paper capacitors are modified plastic-tubular duranite-end-sealed units in paper cases. Operating temperatures of −30 C. to + 100 C. 200, 400 and 600 V. D.C. 0.01 to 2.0 mfd.

Series P123ZNG Aerolene-impregnated metallized-paper capacitors housed in tubular metal cases with vitrified ceramic terminal seal. Operating temperature range of −55 C. to +100 C. at full rating; to +125 C. at 75% of voltage rating. 200, 400 and 600 V.D.C. .0005 to 2.0 mfd.

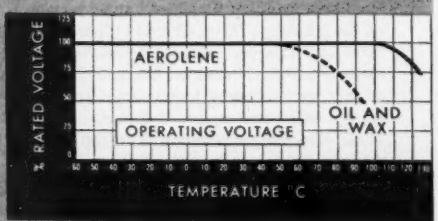




Series P30ZN Aerolene-impregnated metallized-paper capacitors housed in "bathtub" metal cases with vitrified or glass terminal seals. Operating temperature range of −55 C. to +100 C. at full rating; to +125 C. at 75% of voltage rating. Capacitances available from 0.1 mfd. up to 15.0 mfd. at 150 V. D.C., and up to 3.0 mfd. at 600 V. D.C.

Once again, Aerovox is privileged to blaze the capacitor-development trail. For these high-temperature metallized-paper capacitors are definitely Aerovox "firsts" in *conception, production* and *application.*

Their truly phenomenal acceptance is due to (1) The *Space Factor,* especially when *miniaturization* is a prime consideration; (2) *Reliability,* particularly in meeting voltage peaks or surges, by taking advantage of their self-healing characteristics; and (3) *Wide Operating Range,* from sub-zero to elevated temperatures.



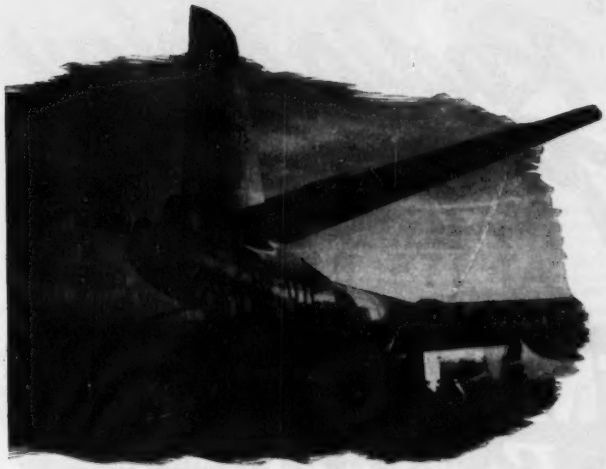
Let us quote on your metallized-paper capacitor needs. Or if you are not already familiar with metallized-paper advantages, our engineers will gladly show you how they can fit your functions and circuits.

THE HOME OF CAPACITOR CRAFTSMANSHIP

AEROVOX CORPORATION, NEW BEDFORD, MASS., U.S.A.

Export: 41 E. 42nd St., New York 17, N.Y. • Cable: AEROCAP, N.Y. • In Canada: AEROVOX CANADA LTD., Hamilton, Ont.

SALES OFFICES IN ALL PRINCIPAL CITIES

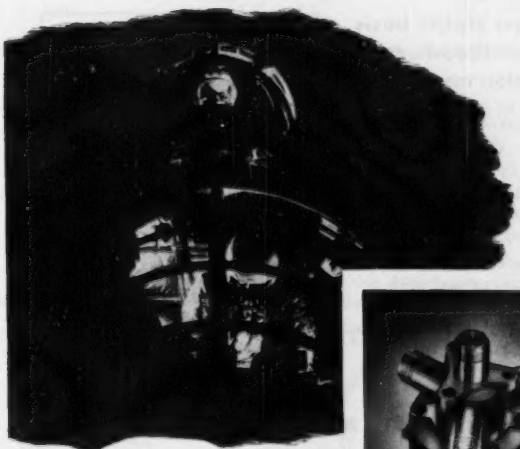


EARS TO HEAR VOICES. Ears with which to "see" and even identify a plane as friend or foe many miles away. Ears for a "homing" device that tells a pilot how far he is from his base.

The ears are antennae. Some planes have 39 to pick up and transmit signals for a dozen different purposes. Some even more.

All depend on electronics. Thompson Products, long a leader in transportation progress, entered this field in the '40s by developing an electronic control for jet engines. Now Thompson is knee-deep in electronics, builds such things as coaxial switches and antennae.

The plane with 39 ears...



The Thompson coaxial switch directs electrical currents, without leakage, at the touch of a finger. The only alternative is making slow, hazardous manual connections.

This amazing switch promises new improvements in radio, television, telephone —wherever high frequency current is used.

In the field of electronics as well as automotive and aircraft parts, you can count on Thompson Products, Inc., Electronics Division, 2196 Clarkwood Road, Cleveland 3, Ohio.

This coaxial switch is a high frequency electronics device, product of the *Thompson Products Electronics Division*. Thompson perfected the means of combining two different plastics and several alloys in a mechanism that would operate only if made to extremely close tolerances.

You can count on Thompson Products

for Radio Relay Performance

AT ITS BEST—IT'S

PTM MICROWAVE by Federal

"FIRST Commercial Radio Relay System in North America"

PTM Provides INDUSTRY with complete, private, high-reliability, weatherproof communications—over any terrain—without costly line construction and maintenance

Federal PTM Microwave offers the most stable basic channels for pipe lines, power utilities, railroads, telephone companies, broadcasting, aviation and others

PROVED performance in all large and small industrial applications! That's why industry can rely on Federal Pulse-Time Modulation Microwave . . . the modern system developed by the world-wide International Telephone and Telegraph Corporation, pioneer in microwave techniques. Tens of thousands of channel-miles of PTM have been installed in 15 countries by IT&T associates.

Federal PTM—providing *all* facilities *simultaneously*—meets *all* communication requirements . . . over long distances and with remarkable reliability, using equipment of highest RF output and simplest design. For details on microwave at its best, write to Wire and Radio Transmission Systems Division, Dept. D-713.

HIGH POINTS of PTM PERFORMANCE

- Unaffected by fog, rain, snow, ice, static or magnetic storm.
- High signal-to-noise ratio.
- Outstanding for high quality of voice and other transmission.
- No inter-channel crosstalk due to non-linearity of common elements.
- Energy beamed by non-critical, directive parabolic reflectors.
- High power allows large fading margin.
- 99.22% reliability achieved without RF stand-by.

FEDERAL TELECOMMUNICATION LABORATORIES, Nutley, N. J. . . . . a unit of IT&T's worldwide research and engineering organization.

"Federal Microwave—The System Backed by 20 Years of Experience"

Federal Telephone and Radio Corporation

100 KINGSLAND ROAD CLIFTON, NEW JERSEY

In Canada: Federal Electric Manufacturing Company, Ltd., Montreal, P. Q.
Export Distributors: International Standard Electric Corp., 67 Broad St., N. Y.

ERIE RESISTOR COMPONENTS

For Easy Assembly
Dependable Performance

ERIE TUBULAR CERAMICONS*

Erie "GP"* Molded Insulated Ceramicons
5 MMF—5,000 MMF

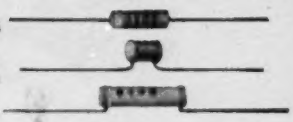
Erie "GP" Dipped Insulated Ceramicons
5 MMF—5,000 MMF

Erie "GP" Non-Insulated Ceramicons
5 MMF—5,000 MMF

Temperature Compensating Molded Insulated Ceramicons
0.5 MMF—550 MMF

Temperature Compensating Dipped Insulated Ceramicons
0.5 MMF—1,800 MMF

Temperature Compensating Non-Insulated Ceramicons
0.5 MMF—1,800 MMF



ERIE CERAMICON TRIMMERS

Style 557
1.5–7 MMF
3–12 MMF
5–25 MMF

Style 3130
5–30 MMF
8–50 MMF
65–95 MMF
150–190 MMF

Style TS2A
1.5–7 MMF
3–12 MMF
3–13 MMF
5–20 MMF
4–30 MMF
7–45 MMF

Style 531 and 532
0.5–5 MMF
1–8 MMF

Style 535
0.7–3.0 MMF

Style 3115
0.5–3.0 MMF
1.0–4.0 MMF

Style 3139
2.0–6.0 MMF

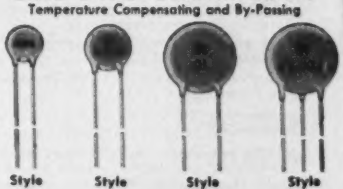
Style 3132
1.0–3.8 MMF

ERIE FEED-THRU CERAMICONS

Style 327
Style 2404
Style 2405
Style 357
Style 362
Style 321
5 MMF—1,000 MMF
5 MMF—1,500 MMF
Style 2416
Style 2418

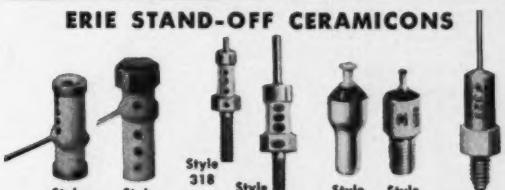
ERIE DISC CERAMICONS

Temperature Compensating and By-Passing



Style 831
Style 801
Style 811
Style 812

ERIE STAND-OFF CERAMICONS

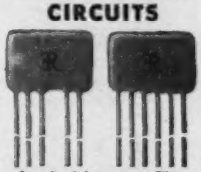


Style 2322
Style 2336
Style 318
Style 319
Style 325
Style 326
Style 323 and 324
5 MMF—5,000 MMF

ERIE BUTTON MICA CONDENSERS

15 MMF—6,000 MMF

ERIE PRINTED CIRCUITS



Standard, Integrator, Filter, and Coupling Circuits

ERIE HIGH VOLTAGE CERAMICONS

Style 412
Style 414
10 and 20 KV.—500 MMF

ERIE CUSTOM MOLDED PLASTICS

Custom Injection Molded Plastic Knobs, Dials, Bezels, Name Plates, Coil Forms, etc.

*Ceramicon, Hi-K, GP, and Plexicon are registered trade names of Erie Resistor Corporation

Electronics Division
ERIE RESISTOR CORP., ERIE, PA.
LONDON, ENGLAND · TORONTO, CANADA

HERMETIC SEALING FOR EVERY REQUIREMENT

NEO-SIL HERMETIC SEAL TERMINALS — Applicable on MIL requirements. Will withstand thermal shock, vibrations, mechanical strains, and excessive pressures with no impairment of the seal or other functional characteristics. E-3LW terminals are now being used at 1000 psi static oil pressure and undergo 5000 psi tests for two minutes.

NEO-SIL OCTAL TYPE PLUG IN HEADERS — Applicable for MIL requirements. These units can undergo sustained vibrations, large temperature changes, and other strains without impairment to the seal or other functional characteristics. Available with eight and twelve pins.

NEO-SIL MULTIPLE PIN HEADERS — Applicable for MIL requirements. Presently being used on MIL-T-27 transformers. These units are available with 2 to 10 pins. These units can undergo conditions mentioned above with no impairment to the seal or other characteristics.

NEO-SIL FUSE HOLDERS, HERMETICALLY SEALED — Available for 3-AG and 4-AG fuses. These units are completely sealed from moisture with or without the cap or fuse inserted. They are applicable on pressurized and gas filled components.

NEO-SIL CABLES, HERMETICALLY SEALED — The cables are hermetically sealed at the plug on thru to the panel.

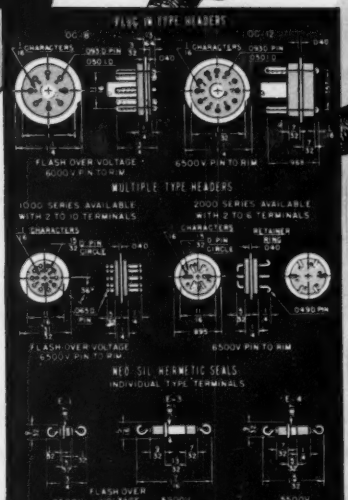
NEO-SIL ROTARY WATERSEAL PANEL ASSEMBLIES — These units have an excellent five year customer history on gas filled pressurized components. They are available for 1/4" shafts and for potentiometers and switch bushings.

NEO-SIL LINE CORDS WITH PLUGS FOR EUROPEAN USE, HERMETICALLY SEALED — These units are completely sealed at the plug and are being used on pressurized units.

NEO-SIL GASKETS, METER, PANEL, COVER, ETC. — Molded from fluoprene for complete sealing.

NEO-SIL ADAPTERS, U. S. TO EUROPEAN, AFRICAN, SOUTH AMERICAN SOCKETS — Our 200A and 300A together will adapt virtually all standard plugs, sockets, and lamp sockets of the above mentioned areas.

NEO-SIL COIL FORMS, CRYSTAL CONTACTS, and other molded bakelite and fluo-Sil rubber units.



TEST DATA

The result of the Electrical Testing Laboratories Inc., Report #330655, dated March 18, 1949, on this material shows the following:

Volume Resistivity at 800 Volts d-c
Room Temperature 25°C R.H. 30 percent

Megohm-inches	*ohm-centimeters*
1.4×10^{8}	3.5×10^{7}

Dielectric Constant and Dissipation Factor

Dielectric Constant	*Dissipation Factor*	*Loss Factor*
	@ 60 cycles per second	
9.22	.058	5.32
	@ 1 megacycle per second	
6.17	.0455	.28
	@ 50 megacycles per second	
5.35	0.20	1.1

Dielectric Strength at 60 cycles
Volts per mil — 370

Durometer Average — 80 ± 5

Temperature — Rated as a Class A material conservatively + 175° to —70° centigrade.

The Flashover Voltages indicated were taken at a temperature of 68° Fahrenheit and 47% Relative Humidity.

We welcome your inquires on any phase of design, development or production.

NEO-SIL CORPORATION

26 CORNELISON AVE., JERSEY CITY 4, N. J.

CHICAGO REPRESENTATIVE: GASSNER & CLARK COMPANY
6349 North Clark St., Chicago 26, Ill.

RF INTERFERENCE SUPPRESSION FILTERS

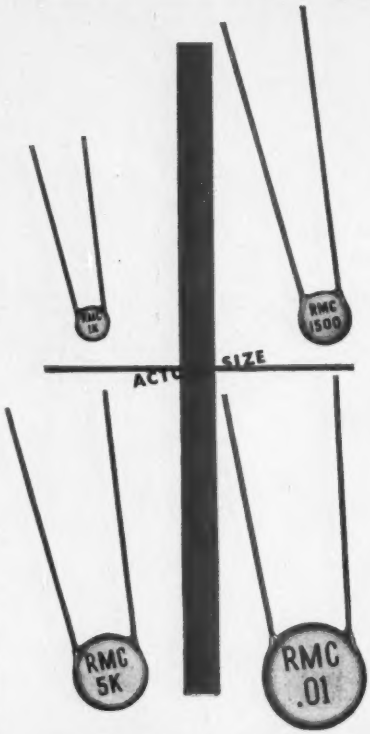
by FILTRON

FLUSHING, LONG ISLAND, NEW YORK

LARGEST EXCLUSIVE MANUFACTURERS OF RF INTERFERENCE FILTERS

Another RMC First!

RMC "HEAVY DUTY" By-Pass DISCAPS



Modern Engineering Requires This

"HEAVY DUTY" CERAMIC CAPACITOR

The heavier ceramic dielectric element made by an *entirely new process* provides the necessary safety factor required for line to ground applications or any application where a steady high voltage condition may occur. Designed to withstand constant 1000 V.A.C. service.

It is wise to specify RMC "HEAVY DUTY" by-pass DISCAPS throughout the entire chassis because they *cost no more* than ordinary lighter constructed units.

Specify them too, for your own peace of mind, with the knowledge that they can "take it." And if you want proof — request samples.

"RMC DISCAPS" *The Right Way to Say Ceramic Condensers*

A New Development from the RMC Technical Ceramic Laboratories

DISCAP CERAMIC CONDENSERS

RMC

RADIO MATERIALS CORPORATION

GENERAL OFFICE: 3325 N. California Ave., Chicago 18, Ill.

FACTORIES AT CHICAGO, ILL. AND ATTICA, IND.

Two RMC Plants Devoted Exclusively to Ceramic Condensers

Getting the message through with PRECISION POINT-TO-POINT COMMUNICATION EQUIPMENT

Every increase in the scope and tempo of events makes its new, more stringent demands of communications science.

Urgent yesterday, today even higher speed, fidelity and dependability—under even tougher conditions—are *vital*. Only continuing advance in modern precision point-to-point communication equipment can accomplish these feats.

Through constant research and exacting manufacture, Northern Radio keeps its lead in supplying our and Allied government and commercial agencies with the foremost in communication equipment.

Write for complete information.

Booth 307, I.R.E. Show.

FREQUENCY SHIFT KEYERS
MASTER OSCILLATORS • DIVERSITY RECEIVERS
FREQUENCY SHIFT CONVERTERS • MULTI-CHANNEL TONE SYSTEMS
TONE KEYERS • DEMODULATORS • RADIO MULTIPLEX SYSTEMS
MONITORS • TONE FILTERS • LINE AMPLIFIERS

Pace-Setters in Quality Communication Equipment

NORTHERN RADIO COMPANY, inc.

147 WEST 22ND STREET, NEW YORK 11, NEW YORK

Name your needs in terminal boards ...we'll meet them accurately

The rigid specifications of government agencies and the armed forces need pose no problem to you. C.T.C. is in an excellent position to handle government sub-contracts for electronic parts and assemblies.

Our Custom Engineering Service is constantly supplying special terminal boards to the top names in electronics. These boards are built to severe government specifications, are fabricated of certified materials to fit the job. Among the specifications involved are: MIL-P-3115A, MIL-P-15037, MIL-P-15035A, MIL-P-15047, MIL-P-997A.

Boards can be made of cloth, paper, nylon or glass laminates (phenolic, melamine or silicone resin), and can be lacquered or varnished to specifications: JAN-C-173 and JAN-T-152. Lettering and numbering is done by rubber stamping, silk screening, hot stamping, engraving. Inks used in rubber stamping contain anti-fungus and fluorescent additives.

Terminals, feed-throughs, mounting hardware and all other terminal board fixtures meet all applicable government specifications.

Standard "All Set" Boards, scribed for easy separation, for the assembly line and laboratory are available in cotton fabric phenolic per specification MIL-P-15035A and in nylon phenolic per MIL-P-15047A.

For complete information write: Cambridge Thermionic Corporation, 437 Concord Avenue, Cambridge 38, Mass. West Coast manufacturers, contact: E. V. Roberts, 5014 Venice Blvd., Los Angeles, or 988 Market Street., San Francisco, Cal.

CAMBRIDGE THERMIONIC CORPORATION

custom or standard... the guaranteed components

CTC

See our listing in Electronics Buyers' Guide

Air-cooled!

NEW G-E U-H-F POWER TUBE FOR TELEVISION

1 KILOWATT OUTPUT...
without water supply—
without piping—
without water connections!

900 MC FREQUENCY...
All TV bands are covered.

ULTRA-MODERN DESIGN...
Includes ceramic construction, wide-surface ring contacts, many other advanced features.

GL-6183

See G.E.'s brand-new 1-kw *air-cooled* tetrode at the I.R.E. show in New York, March 3 to 6. Or write today for descriptive bulletin ETD-504. *Electronics Division, Section 10, General Electric Company, Schenectady 5, New York.*

GENERAL ELECTRIC

If you want to **get tough** *in your assemblies,*

In the heavy-weight division — fixed and adjustable Greenohms — up to 200 watt.

specify

greenohm*

power resistors

*The green-colored power resistors so conspicuous these days in dependable radio-electronic and electrical assemblies, are GREENOHMS. *No tougher resistors made.* That statement is sustained by laboratory tests. Likewise by countless case histories out in the field.

Unimpaired wire winding firmly imbedded in exclusive cold-setting inorganic cement. Exceptional heat conduction and surface radiation. Heavy overloads handled without damage. Severe heat-shock resistance permits extreme on-off operation without flinching. And Greenohms last and last.

Choice of standard types. Also in virtually unlimited special types. Wide selection of resistance values, wattages, taps, terminals, mountings. And remember, *Greenohms cost less* though they offer you more!

Greenohm Jr. — point-to-point wired power resistor sealed in ceramic tubular casing. 4, 7 and 8 watt.

Flat Greenohms for flat mounting individually, or for stacked arrays. 30 to 75 watt.

In the bantam-weight division — 5 and 10 watt fixed Greenohms.

Standees — convenient above-chassis mounting Greenohms in ceramic casings. 10 to 25 watt.

What is the ideal resistance value? That's easy. With the Clarostat Power Resistor Decade Box inserted in actual circuit, handling actual load, you try the six knobs for anything from 1 to 999,999 ohms. When right operating conditions are attained, read resistance directly off dials. Quick, simple, positive, economical.

***you can* stand pat *with* clarostat**

Engineering data on request. Send us your resistance or control requirements for engineering aid and quotations. Try Greenohms!

CLAROSTAT

Controls and Resistors

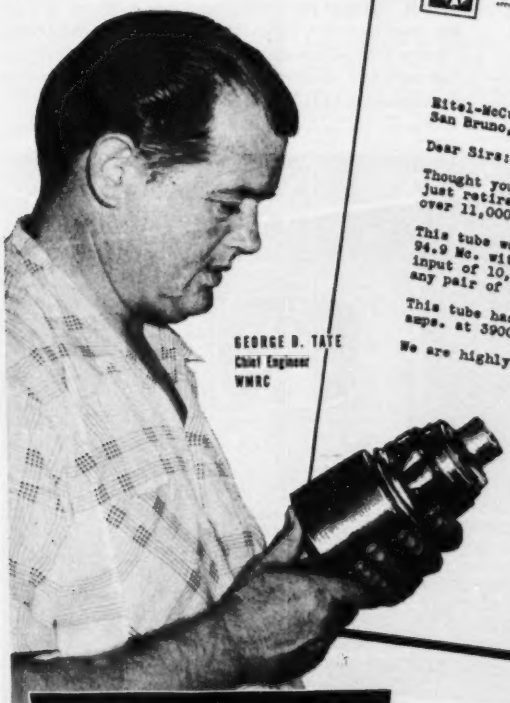
CLAROSTAT MFG. CO., INC., DOVER, NEW HAMPSHIRE

In Canada: Canadian Marconi Co., Ltd., Toronto, Ontario

RETIRED...

*One Eimac 3X2500A3 . . . after 11,000 hours of FM broadcast service on 94.9 Mc

Before Eimac tubes are put out to pasture, they earn their retirement. Here's a typical story:



GEORGE D. TATE
Chief Engineer
WMRC

TEXTILE BROADCASTING COMPANY
Radio WMRC Station
GREENVILLE, S. C.

Eitel-McCullough, Inc.
San Bruno, California

Dear Sirs:

Thought you may be interested to know that we have just retired one of your 3X2500A3 tubes with a little over 11,000 hours of use.

This tube was used in our FM Station which operates on 94.9 Mc. with an ERP of 79,000 watts; this means an input of 10,5000 watts which in my opinion is pushing any pair of tubes for FM service.

This tube had to operate at a plate current of 1.35 amps. at 3900 volts.

We are highly pleased with this tube.

Very truly yours,

Radio Station WMRC-WMRC-FM

George D. Tate

George D. Tate
Chief Engineer

FOLLOW THE LEADERS TO Eimac TUBES THE POWER FOR R.F.

* For complete technical data on the 3X2500A3 or 3X2500F3 triodes...or any other Eimac tube, write:

EITEL-McCULLOUGH, INC.
SAN BRUNO, CALIFORNIA

EXPORT AGENTS: FRAZAR & HANSEN • 301 CLAY STREET • SAN FRANCISCO 11, CALIFORNIA

Speed Nut
SAVINGS STORIES

Unique SPEED NUT Stars on Bendix Television

Product of Bendix Aviation Corporation

How multiple-function SPEED NUT made 40% savings in the assembly of TV transformer

Like the juggling stars on television, this new fastener does several jobs at one time . . . and provides several important cost-savings advantages.

Bendix Television engineers discovered this in their search for a better, simpler way of assembling high voltage transformers. Selected because it was engineered to do this specific job, this unusual Tinnerman fastener: *(1) replaced 4 parts, thereby reducing parts handling; (2) cut material costs 50%; (3) provided a 40% savings in cost of assembling transformer.*

It is through improvements and economies like this that Bendix Television, Baltimore, Md., is able to supply top quality "Front-Row" television receivers for thousands of American homes. You, too, can step up product quality and make production dollars go farther with SPEED NUTS. Your Tinnerman representative can show you how. Call him soon—and write for your edition of "Savings Stories"—actual case histories of leading manufacturers. TINNERMAN PRODUCTS, INC., Dept. 12, Box 6688, Cleveland 1, Ohio. In Canada: Dominion Fasteners Ltd., Hamilton. In Great Britain: Simmonds Aerocessories, Ltd., Treforest, Wales.

SPEED NUT holds transformer cores in spring tension grip, secures base by receiving 4 screws from below, and anchors top section with threaded shaft. One-piece fastener replaces 2 side fasteners, 1 bottom piece, 1 spring.
New Bendix Console Model
TINNERMAN Speed Nut

for quality, price and delivery... you can't beat **ASTRON**

MAKE ARROW ELECTRONICS YOUR HEADQUARTERS

QUALITY for ASTRON CAPACITORS

TYPE ML METALITE*

Cardboard tubulars, vacuum impregnated in a microcrystalline hydrocarbon wax, suitable for service at temperatures up to 65° C. WVDC 200 to 600; capacities .01 to 2.0 mf. Double mineral wax coating for superior moisture-resistance. Soldered metal end-caps assure greater mechanical strength.

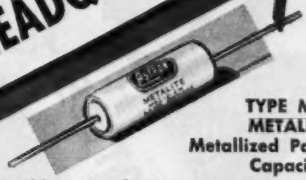
TYPE AQ Subminiature Paper Capacitors

For 125° C Operation

Fulfills the demand for extremely reliable subminiature capacitors for operation at ambient temperatures from—65° up to and including 125° C *without derating*. Provides capacitance stability, high insulation resistance, low power factor, high test voltage. Supplied only in extended foil, non-inductive type construction. Glass-to-metal seal terminals. Meets all the stringent and exacting Armed Forces requirements. WVDC from 100 to 600, capacities from .0047 to 1.0 mf, depending on voltages. Sizes range from .235x 11/16" to .750x 2 1/16" in a variety of hermetically sealed metal tubular case and construction styles.

ASTRON ENGINEERING DATA BOOK AVAILABLE

Arrow will be glad to supply an exceptionally well prepared engineering data book and complete listing of all standard ASTRON Capacitors and Filters for Electronic Applications. Vital information on standard types, as well as details on special capacitors for your specific requirements, is contained. Request Astron Book EC on your firm letterhead, and it will be forwarded at once, gratis.



TYPE MQC METALITE* Metallized Paper Capacitors

Type MQC Metalite* Capacitors are encased in tinned, non-ferrous cases with glass-to-metal hermetic terminal seals. They are *ultra-compact*, self-healing—and are ideally suited for military and aircraft applications since they meet the highest exacting requirements for rigorous service. Positively sealed against moisture with glass-to-metal terminal at one end, or both ends (Type MQCF) at slight extra cost. Can be furnished with plastic insulating sleeve when required. Mineral wax impregnated—Type MQM available with mineral oil impregnation. Standard tolerance: —15 + 25%.

Catalog Number	CAP. MF.	Size Diam.	Size Length	Net Price
200 Volts DC Working				
MQC-2-01	.01	.235 x	¾	$1.20
MQC-2-02	.02	.235 x	¾	1.24
MQC-2-05	.05	.235 x	¾	1.24
MQC-2-1	.1	.312 x	¾	1.27
MQC-2-25	.25	.400 x	¾	1.39
MQC-2-5	.5	.400 x	1-1/16	1.42
MQC-2-1M	1.0	.562 x	1¾	1.86
MQC-2-1.5M	1.5	.562 x	1¾	1.63
MQC-2-2M	2.0	.670 x	1¾	2.33
400 Volts DC Working				
MQC-4-01	.01	.235 x	¾	1.20
MQC-4-02	.02	.235 x	¾	1.24
MQC-4-05	.05	.312 x	1-1/16	1.29
MQC-4-1	.1	.400 x	1-1/16	1.33
MQC-4-25	.25	.562 x	1-1/16	1.45
MQC-4-5	.5	.562 x	1¾	1.62
MQC-4-1M	1.0	.670 x	2¼	1.80
MQC-4-2M	2.0	1 x	2¼	2.74
600 Volts DC Working				
MQC-6-01	.01	.235 x	¾	1.27
MQC-6-05	.05	.312 x	1-1/16	1.33
MQC-6-1	.1	.400 x	1-1/16	1.36
MQC-6-25	.25	.562 x	1¾	1.59
MQC-6-5	.5	.670 x	1¾	1.77
MQC-6-1M	1.0	.750 x	2¼	2.15
MQC-6-2M	2.0	1 x	2¼	3.03

EXTRA DISCOUNTS AVAILABLE TO QUANTITY USERS

* Trade Mark

ASTRON Electrolytics for TV & Radio

Popular acceptance of ASTRON Type EV Twist Prong Dry Electrolytics has been proven by its ever increasing use by leading TV and radio manufacturers.

ASTRON Minimite (Type MM) Tubular Dry Electrolytics are compact, high quality capacitors ideal for use where long life and limited space are essential factors.

VISIT ARROW'S I.R.E. SHOW EXHIBIT

Arrow's big exhibit in Theatre 318, at the I.R.E. Show at the Grand Central Palace in New York, March 3rd to 6th, will be something you'll want to see. Arrow, America's greatest single source for everything in electronics, will exhibit new electronic items and components of great interest to everyone concerned with Electronics.

MAKE ARROW ELECTRONICS YOUR HEADQUARTERS FOR EVERYTHING IN INDUSTRIAL ELECTRONICS

The fine line of top-quality ASTRON Capacitors is but one of the many nationally famous and widely accepted lines of industrial electronic equipment always in stock at Arrow. Alert engineers, designers, laboratories, institutions and Government agencies are thoroughly convinced that Arrow has become America's number one source for all their needs in industrial electronics.

ALL NAME BRANDS ALWAYS IN STOCK

Our big warehouses are thoroughly stocked with equipment, components and parts of every standard electronics manufacturer you can name. Whatever your requirements may be, for pilot models or complete production runs, for experimentation or exhaustive comparison testing, you will find Arrow ready to supply at almost a moment's notice.

EXPERIENCED SALES PERSONNEL

Arrow's Industrial Sales Department is staffed by experienced men with many years of know-how in helping you solve your material problems. Not mere telephone order-takers, these experts are fully conversant with your requirements. Their advice is sought after daily by the nation's leading electronics organizations who must have a dependable source of supply and information.

ULTRA-SPEED DELIVERY

Where time is of the essence you can rely on Arrow every time. Our efficient order-pickers and competent shipping department get your orders on to you with the greatest possible dispatch. Over 93% of our orders are processed and shipped on the day of receipt, a record unmatched by any supplier in the electronics industry.

For dependability, for service, for speed—you can't beat Arrow. Try us, NOW!

ARROW ELECTRONICS INC.

NEW YORK 7, N. Y. • 131 CORTLANDT ST. • BARCLAY 7-7844

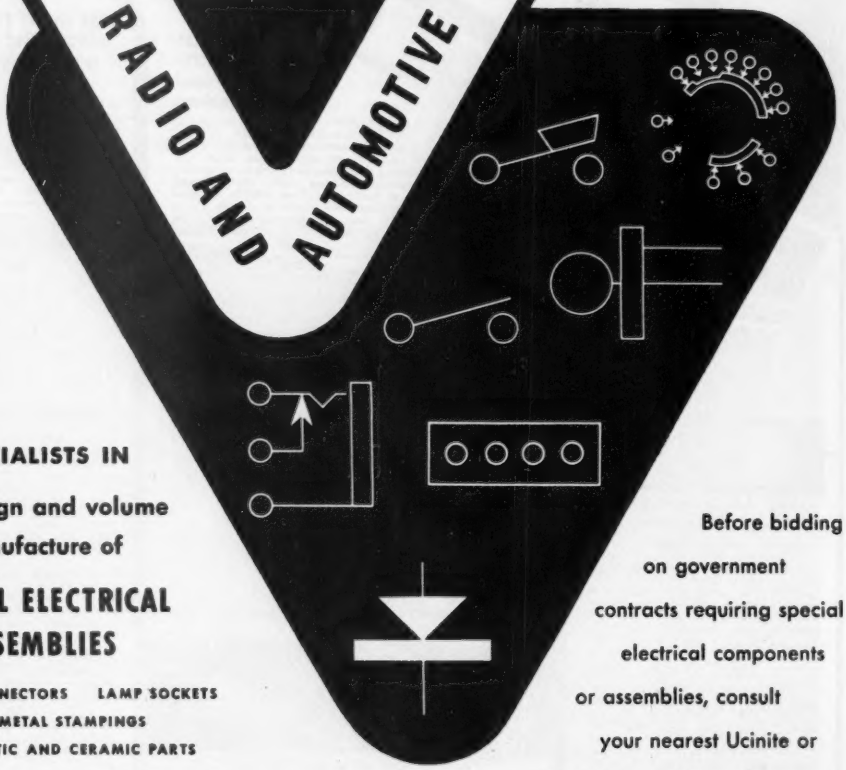
ARROW ELECTRONICS • WUX N. Y.

TELETYPE NY-1-472

ELECTRICAL ASSEMBLIES

Ucinite

RADIO AND AUTOMOTIVE



SPECIALISTS IN

the design and volume manufacture of

SPECIAL ELECTRICAL ASSEMBLIES

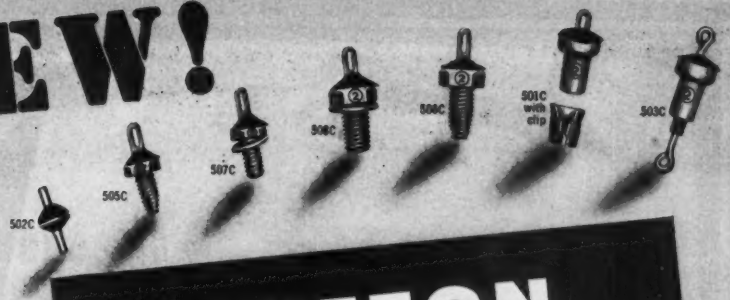
SWITCHES CONNECTORS LAMP SOCKETS
SPECIAL METAL STAMPINGS
MOLDED PLASTIC AND CERAMIC PARTS

Before bidding on government contracts requiring special electrical components or assemblies, consult your nearest Ucinite or United-Carr field engineer.

The UCINITE COMPANY NEWTONVILLE 60, MASS.

Division of United-Carr Fastener Corp.

NEW!



BUTTON CERAMIC CAPACITORS

. . . FOR TV AND U-H-F DESIGN

Design of electronic equipment and TV receivers for the higher frequencies is simplified by a new series of button ceramic capacitors developed by Sprague. A completely new construction using a disc capacitor element instead of the conventional dielectric tube results in higher self-resonant frequencies and improved circuit efficiency.

For bypass applications, Types 505C, 506C, 507C, and 508C are unique. The dielectric button is housed in a recess in the top of a hex-head machine screw and is sealed against moisture by a plastic resin. This shielded construction minimizes ground inductance and keeps it at a fixed value while providing a short bypass path to ground, which is radially uniform over the capacitor element. The lug terminals are essentially at tube socket terminal height to help maintain short, uniform lead lengths.

Type 501C is a ferrule shank bypass capacitor for push-clip mounting in TV receivers while type 503C is its feed-thru counterpart. The disc capacitor element is resin-sealed in a recess in the top of the metal shell.

Type 502C "shirt-stud" capacitors are ¼" diameter buttons intended for coupling in u-h-f TV set front ends.

All units are rated at 500 volts d-c and are available in both characteristic SL and GA general application bodies.

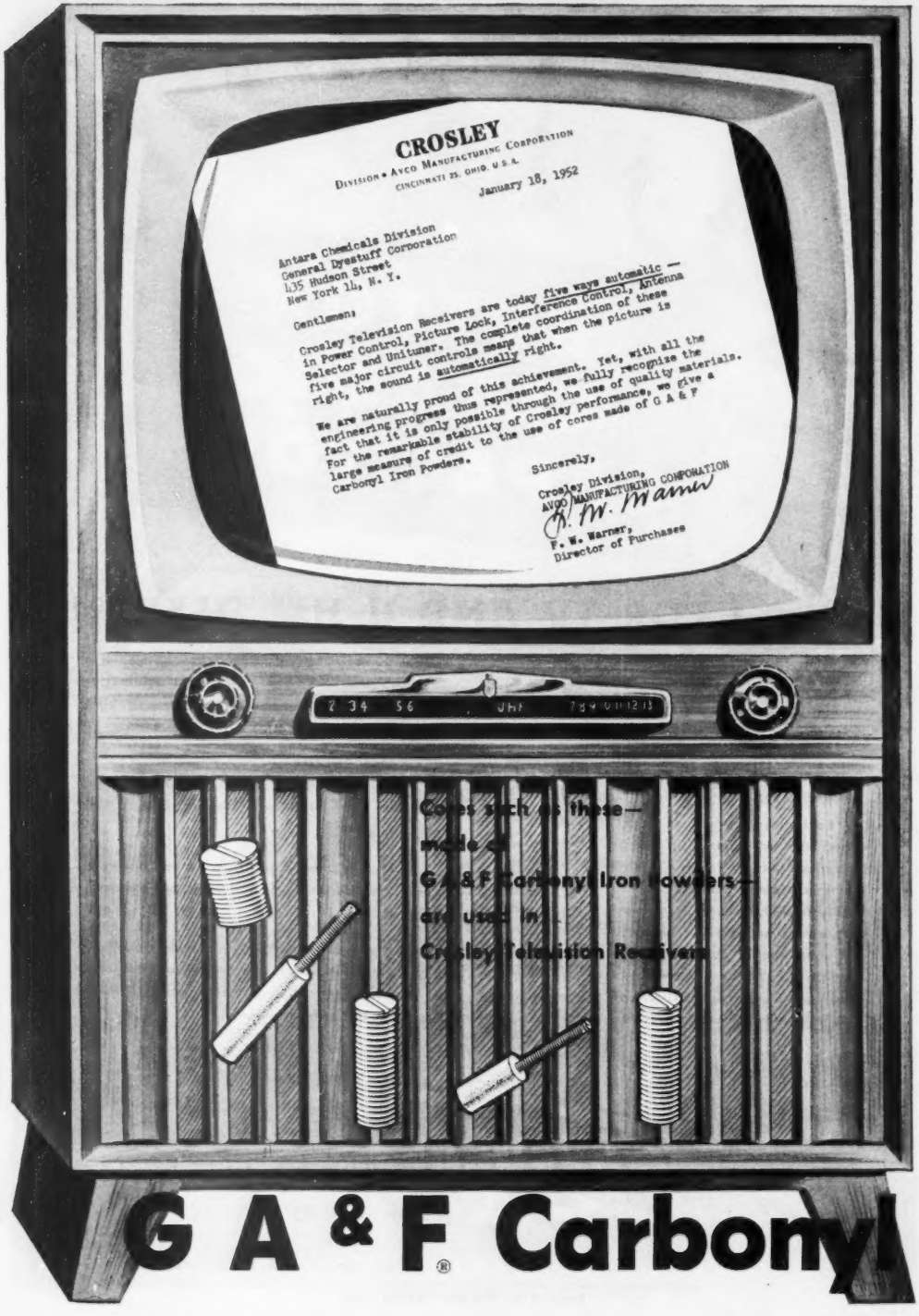
Engineering Bulletin 605 gives complete details on these new and different capacitors. Request it today on your company letterhead from Sprague Electric Company, North Adams, Mass.

PIONEERS IN ELECTRIC **SPRAGUE** AND ELECTRONIC DEVELOPMENT

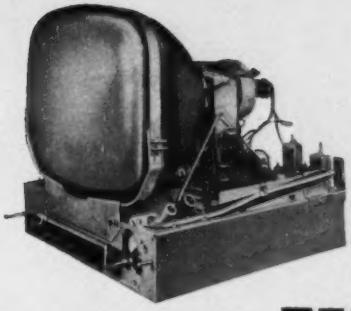
NEW HIGH-VOLTAGE CERAMIC DISCS

Sprague Cera-mite Capacitors are now available in 1000 and 1300 volt ratings as well as in the usual 500 volt ratings. Write on letterhead for Bulletin 601C.

See Us at the I.R.E. Show—Booths 27-28


CROSLEY
DIVISION • AVCO MANUFACTURING CORPORATION
CINCINNATI 25, OHIO, U.S.A.
January 18, 1952
Antara Chemicals Division
General Dyestuff Corporation
435 Hudson Street
New York 14, N. Y.
Gentlemen:
Crosley Television Receivers are today five ways automatic — in Power Control, Picture Lock, Interference Control, Antenna Selector and Unituner. The complete coordination of these five major circuit controls means that when the picture is right, the sound is automatically right.
We are naturally proud of this achievement. Yet, with all the engineering progress thus represented, we fully recognize the fact that it is only possible through the use of quality materials. For the remarkable stability of Crosley performance, we give a large measure of credit to the use of cores made of G A & F Carbonyl Iron Powders.
Sincerely,
Crosley Division,
AVCO MANUFACTURING CORPORATION
F. W. Warner,
Director of Purchases
Cores such as these—
made of
G A & F Carbonyl Iron Powders—
are used in
Crosley Television Receivers
G A & F Carbonyl

Behind the Scenes in CROSLEY *Automatic* TELEVISION



there are *Quality-Engineered Components*

Superior performance in a television receiver bespeaks a measure of quality that carries through to the last detail. In Crosley Automatic Television this means a combination of the finest engineering with materials and component parts that are likewise quality-engineered. The high-frequency, permeability-tuned circuits use cores made from G A & F Carbonyl Iron Powders. Stability of performance—under all conditions of temperature, humidity and magnetic shock—is one of the major results.

Crosley Television Receivers and G A & F Carbonyl Iron Powders are both made under the most exacting standards of Quality Control—to insure characteristics and uniformity on which the user can always rely. . . . We urge you to ask your core maker, your coil winder, your industrial designer, how G A & F Carbonyl Iron Powders can increase the efficiency and performance of the equipment you make, while reducing both the cost and the weight. Let us send you the book described below.

THIS WHOLLY NEW 32-PAGE BOOK *offers you the most comprehensive treatment yet given to the characteristics and applications of G A & F Carbonyl Iron Powders. 80% of the story is told with photomicrographs, diagrams, performance charts and tables. For your copy —without obligation—kindly address Department 17.*

gdc ANTARA

ANTARA® CHEMICALS

DIVISION OF

GENERAL DYESTUFF CORPORATION

435 HUDSON STREET • NEW YORK 14, NEW YORK

Iron Powders . . .

MEMBER mpa METAL POWDER ASSOCIATION

PRECISION RESISTORS . . . FOR PRECISION ELECTRONICS

MEPCO

- Precision Wire Wound Resistors: JAN-R-93, and Commercial
- External Meter Multiplier Resistors: JAN-R-29
- Pre-Wired Resistor Switch Assemblies
- Other Types to Your Specifications

MEPCO, INC., MORRISTOWN, NEW JERSEY

Visit our booth N-8 at the I.R.E. Show

ARE YOU DESIGNING A TRANSFORMERLESS TV CHASSIS?

Additional 15-volt Bonus in B+ Voltage now possible with new G-E Germanium Power Rectifier

- A B+ supply that delivers 15 volts more than selenium rectifiers in transformerless TV sets.
- Ultra-thin construction for compact, lightweight assemblies.
- Ultra-long life and reliability, even under severe operating conditions.

Specifications

Description and Maximum Ratings
TYPE G-10

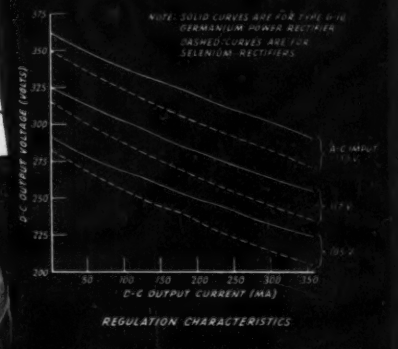
Ambient Temperature	40°C	55°C	65°C
RMS Input Voltage (Max.)	130	130	130 Volts
RMS Current (Max.)	1.2	1.2	.2 Amps
D-C Output Current (Max.)	400	350	50 Ma
D-C Surge Current (Max.)	25	20	2.5 Amps
Peak Forward Current (Max.)	3	3	.5 Amps
Peak Inverse Voltage (Max.)	400	400	400 Volts
Full Load Voltage Drop (Max.)	1.5	1.4	1.3 Volts
Operating Frequency (Max.)	50	50	50 Kc

ALSO AVAILABLE

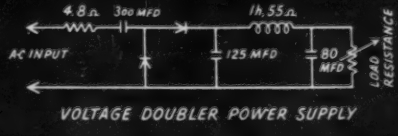
Single Rectifier Types		G-10A	G-10B	G-10C
RMS Input Voltage (Max.)	25°C	32	50	65 Volts
D-C Output Current (Max.)	25°C	200	200	200 Ma
Peak Inverse Voltage (Max.)	25°C	100	150	200 Volts

Typical B+ Voltages for Low, Nominal and High Lines

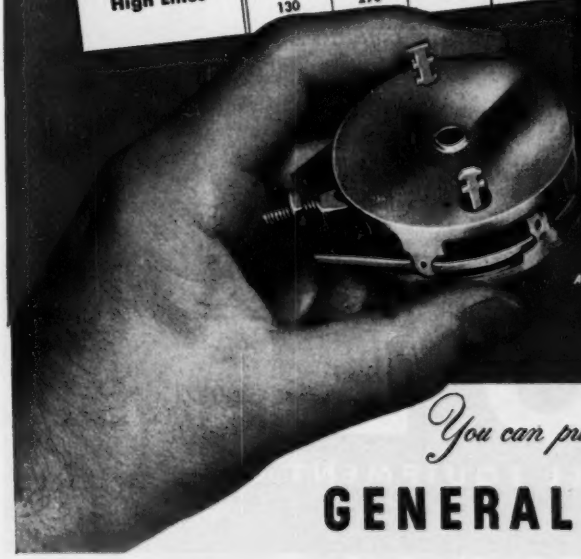
A-C Input Voltage	D-C Output Voltage $R_L = 900$	$R_L = 1000$	$R_L = 1100$
105	240	243	247
117	266	270	273
130	296	302	305



REGULATION CHARACTERISTICS



VOLTAGE DOUBLER POWER SUPPLY



You can put your confidence in—

GENERAL ELECTRIC

IF IT'S SHEET METAL
FABRICATION . . . CALL ON
COLE
STEEL EQUIPMENT COMPANY
Tough assignments are part of our day's work. Whatever the product — instrument housings, boxes, chassis—we're geared to design, fabricate, and finish.
Years of experience and a superbly equipped plant give meaning to our statement: "If you have a sheet metal problem, we can solve it".
Inquiries Invited
manufacturers of the famous Cole steel office equipment
COLE
COLE STEEL EQUIPMENT CO.
285 Madison Ave., New York 17, N. Y.
Factory: York, Pa.

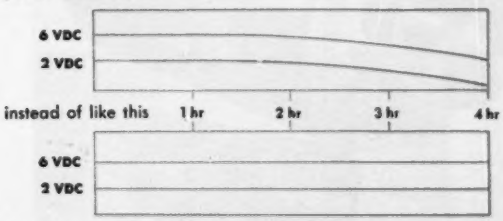
NOW FOR SPECTROPHOTOMETERS...

AN ISOTRONIC DC POWER SOURCE

ACCURATE TO ±0.01%

Model E-6/2-5

The best of spectrophotometers operates erratically when input power looks like this



Haven't you been plagued by input voltage drop, particularly in the course of long-running experiments? Or have you had to interrupt or defer work while batteries were being charged or replaced?

The Sorensen Model E-6/2-5 Nobatron* has been specifically designed to exclude this difficulty. Using it, you can be sure your equipment is getting 2 and 6 volts DC, **plus or minus 0.01%**, with that accuracy maintained indefinitely at normal room temperature.

Furthermore, circuitry developed for the Model E-6/2-5 Nobatron is advanced in simplicity, involving no moving parts. That means easy maintenance, trouble-free operation.

Write for information.

SPECIFICATIONS

Input voltage range	95-130VAC, 1φ, 50-60 cycles
Output	
#1 for lamp	6VDC adjustable ±10% at 5 amperes
#2 for filament	6VDC at 100 Ma.
#3 for bias	2VDC adjustable ±10% at 100 Ma.
Filtering	
#1	1% max.
#2 & 3	0.05% max.
Regulation accuracy	±0.01% against line changes
Time constant	0.1 seconds under most severe line changes
Size:	17 x 12¼ x 17 self contained 19 x 12¼ panel for relay rack mounting
Weight:	Approximately 90 pounds
Meters:	No meters are provided due to the extreme regulation accuracy involved.

*Reg. U. S. Pat. Off. by Sorensen & Co., Inc.

FOR THE LATEST AND BEST IN ISOTRONICS . . .

SORENSEN

SORENSEN AND COMPANY • 375 FAIRFIELD AVE., STAMFORD, CONN.

EICOR

Precision Built

MOTORS *and* DYNAMOTORS

EICOR D. C. MOTORS have been developed to a high degree of efficiency. They are remarkably light in weight for power output — thoroughly reliable — and are used to actuate instruments, turrets, fire control and other critical equipment. From design to production, every detail of construction is a series of precise operations. This specialized skill is reflected in quiet, vibrationless, long-lived performance. It also means better motors at lower cost in the widest range of types and sizes.

MAXIMUM POWER PER OUNCE OF WEIGHT

EICOR DYNAMOTORS furnish the necessary high voltage power for communications, direction finding, radio compass and other controls. Engineered and built by specialists, they have earned their fine reputation through years of exacting service in aircraft. That's why Eicor Dynamotors are so frequently specified for critical applications.

Eicor produces a Dynamotor for *every* need — from the smallest in size to the largest in output. Our complete line of frames makes possible the widest available range of dynamotor output ratings, in the most compact sizes and weights.

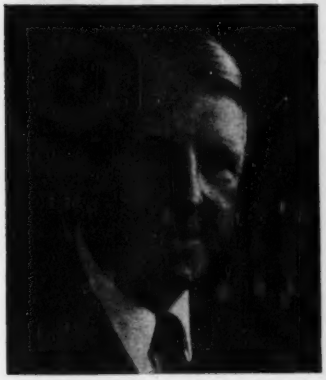
MOTORS AND DYNAMOTORS *Specially Designed* **For INDIVIDUAL APPLICATIONS**

EICOR

Eicor, Inc. 1501 W. Congress St., Chicago 7, Illinois

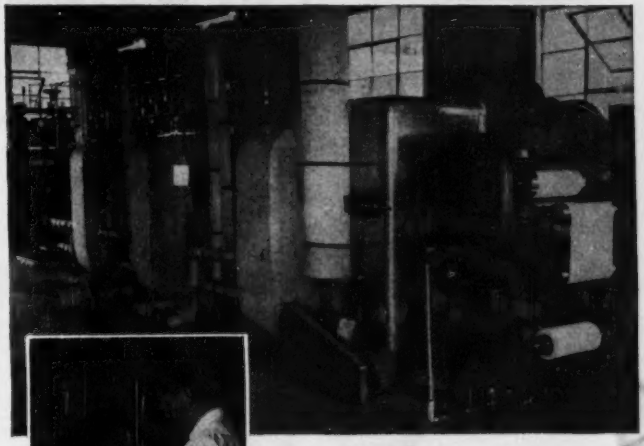
DYNAMOTORS · INVERTERS · ELECTRONIC CONTROLS · ALTERNATORS · MOTORS

Men who design, engineer and buy America's products rely on..and use..National Laminated Plastics because..



"At National, engineering research is of prime importance. We believe only through it and by large investment in it are we able to: *first*, provide industry with dependable laminated plastics for the efficient production of today's products which were developed yesterday; *second*, give practical assistance to the design engineer who is creating today, new, better products for tomorrow."

J. Warren Marshall, **President**
National Vulcanized Fibre Co.



At the Proving Grounds

Here is the Phenolite Pilot Plant—coating machine and press in miniature—where under exact commercial production conditions, testing and experimental work are conducted on thermo-setting products requiring special resins or base materials. This is representative of the research engineering facilities National provides in which over a million dollars are invested.

Stiegler's Fungus House

Frederick L. Stiegler directed the pioneering research that came up with a fungus-resistant vulcanized fibre, satisfactory for extended exposure to moist, warm air. This new grade of National Vulcanized Fibre has important use in refrigerators and products that must perform in fungus-generating climates.

National Laminated Plastics
nationally known — nationally accepted

NATIONAL VULCANIZED FIBRE

A tough horn-like material with high dielectric and mechanical strength. Excellent machinability and forming qualities, great resistance to wear and abrasion, long life, lightweight. Sheets, Rods, Tubes, Special Shapes.

PHENOLITE since **Laminated PLASTIC**

Phenolite possesses an unusual combination of properties—a good electrical insulator, great mechanical strength, high resistance to moisture; ready machinability, lightweight. Sheets, Rods, Tubes, Special Shapes.

Just published! National Laminated Plastics Handbook. Write for copy. Your company letterhead please.

National Vulcanized Fibre Co.

Wilmington *Offices in* Delaware *Principal Cities*

Since 1873

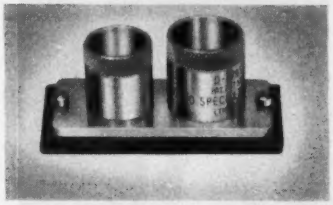
MINIATURE ELECTRON TUBE

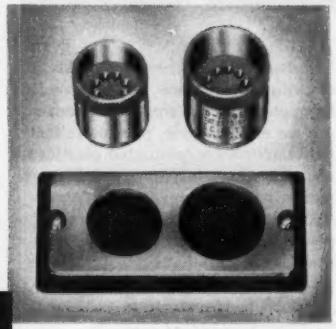
DURO

Pin Straightening Tools

TYPE NO. D-279 S

Dual Unit for Straightening 7-Pin and 9-Pin Tubes — For use in Test Equipment, Radio and Radar.





(ILLUSTRATED ABOVE)

D-279 S ASSEMBLED, illustrating compact design and simple 2-screw mounting.

D-279 S DISASSEMBLED, showing 7-pin and 9-pin straightening dies in removable guides.

U. S. PATENT NO. 2573198

A quality pin straightening tool of precision accuracy. Ruggedly constructed with stainless steel straightening dies fitted into removable, knurled and threaded aluminum guides. Rectangular aluminum base plate. New design prevents jamming — broken pins easily removed without disturbing base plate mounting. Tested and approved by U. S. Army Signal Corps for use by the Armed Services. Now finished per U. S. Army Specification 72-53, if desired. Individual 7-pin and 9-pin units also available. Prompt delivery on defense orders.

Write for quantity price list and further information.

TYPE NO. D-200

Precision, double-ended hand tool with knurled aluminum handle and stainless steel 7-pin and 9-pin straightening dies. Designed for positive ejection of broken pins. Approved for use by the Armed Services.

DURO **SPECIALTY COMPANY, Inc.**

811 BOSTON STREET, WEST LYNN, MASSACHUSETTS · PHONE LYnn 3-3585

CLEVELITE* COSMALITE*

LAMINATED PHENOLIC TUBING.

THESE Ten Grades of Laminated Phenolic Tubing are being used in the Electronic and Electrical industries with astonishing success!

Note how varied are their properties . . . how endless in variety are the diameters, lengths, and wall thicknesses in which this tubing is produced by us.

A GRADE FOR EVERY NEED!

CLEVELITE

Grade **E**.....Improved post cure fabrication and stapling.
Grade **EX**....Special grade for TV deflection yoke sleeve.
Grade **EE**....Improved general purpose.
Grade **EEX**...Superior electrical and moisture absorption properties.
Grade **EEE**...Critical electrical and high voltage applications.
Grade **XAX**..Special grade for government phenolic specifications.

COSMALITE

Grade **SP**....Post cure fabrication and stapling.
Grade **SS**....General purpose.
Grade **SSP**...General purpose—punching grade.
Grade **SLF**...Thin wall tubing—high dielectric and compression strength.

Tell us your needs. We are known for our dependable service and prompt deliveries.

Why pay more?
. . . for the best
call CLEVELAND.

The CLEVELAND CONTAINER Co
6201 BARBERTON AVE. CLEVELAND 2, OHIO

PLANTS AND SALES OFFICES at Plymouth, Wisc., Chicago, Detroit, Ogdensburg, N.Y., Jamesburg, N.J.
ABRASIVE DIVISION at Cleveland, Ohio
CANADIAN PLANT: The Cleveland Container, Canada, Ltd., Prescott, Ontario

REPRESENTATIVES

NEW YORK AREA R. T. MURRAY, 604 CENTRAL AVE., EAST ORANGE, N. J.
NEW ENGLAND R. S. PETTIGREW & CO., 62 LA SALLE RD., WEST HARTFORD, CONN.
CHICAGO AREA PLASTIC TUBING SALES, 5315 N. RAVENSWOOD AVE., CHICAGO

"They didn't stay sold . . ."

There they were . . . forty-four of them . . . sleek, trim hair dryers . . . styled by a nationally famous designer . . . full of eye-appeal and buy-appeal . . . but every last one was going back to the manufacturer. Why? — because they didn't stay sold. Out of the five original sales, four were already back. Irate customers had brought them in . . . they had worked for awhile and then shorted out . . . investigation showed that the electrical insulation wouldn't stand the heat. The Electric Sales Company couldn't take chances on future customer good-will with merchandise like that . . . and it would be a long time before that particular manufacturer got another order from them.

Whether you make home appliances, radio or electronic equipment, or industrial machinery, you need the extra protection of BH Fiberglas Insulations to guard against insulation failure, product breakdown, loss of customer good-will.

Take BH Special Treated Fiberglas Sleeving, for example. Here is a high heat insulation with remarkable resistance to sub-zero temperatures as well.

Dielectric and physical properties remain unchanged through a temperature range of −67° F. to 1200° F. BH Special Treated is permanently flexible, there are no impregnants or coatings to age or harden. But it is not completely limp. A patented heat process gives the sleeving body and rounds it . . . crimps crossing strands to prevent raveling and minimize fraying. It will not ravel when cut in short lengths, or when spread to cover knobs, terminals and irregular objects. Installation time is speeded.

BH Special Treated Fiberglas Sleeving is one of a family of electrical insulations, each designed to meet particular conditions in service. Give us a few facts about your requirements – product, temperatures, voltages—we will gladly furnish samples for testing purposes.

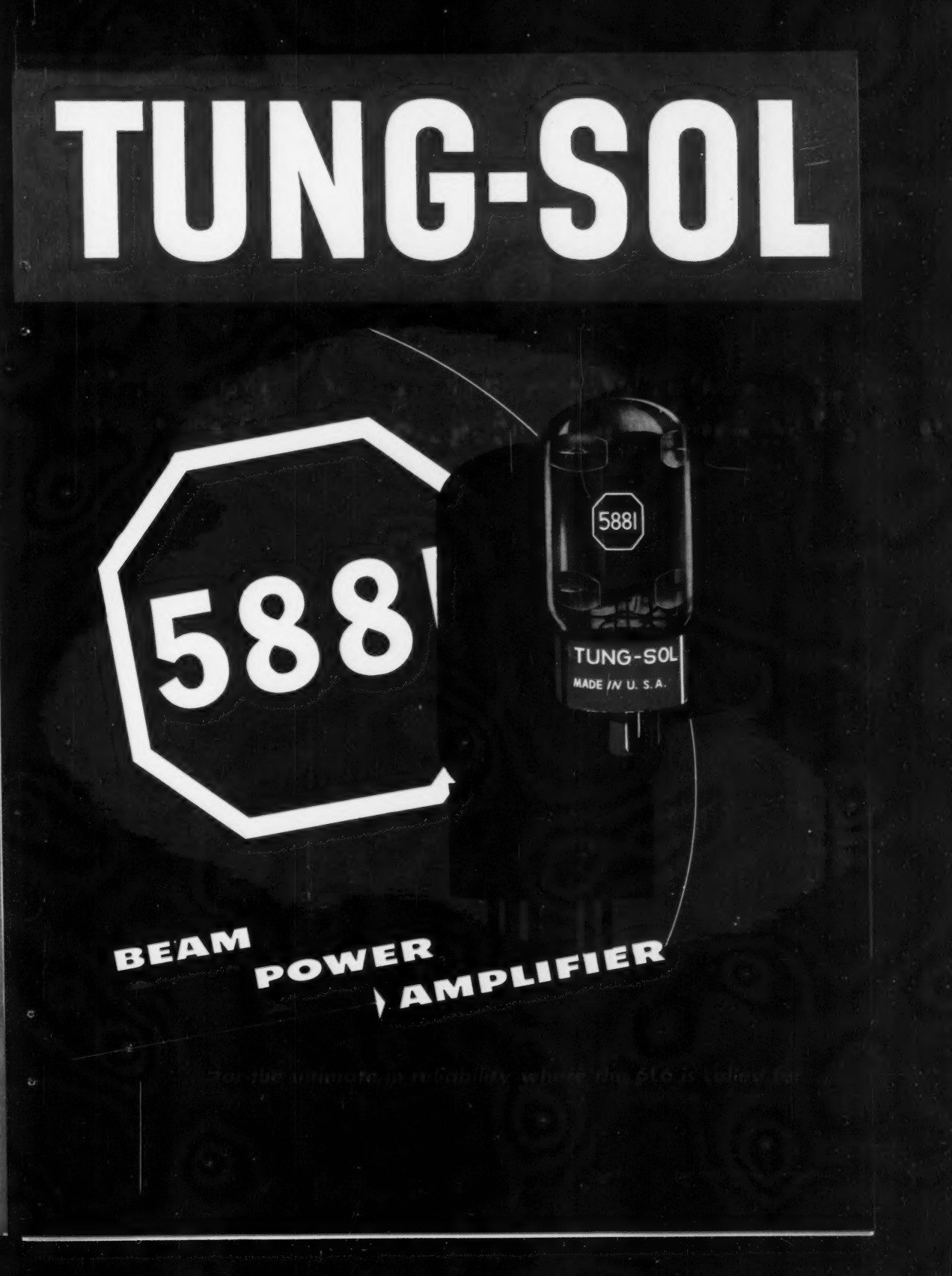
Address Dept. E-3

Bentley, Harris Manufacturing Co.
Conshohocken, Pa.

BH Fiberglas* SLEEVINGS

*BH Non-Fraying Fiberglas Sleevings are made by an exclusive Bentley, Harris process (U. S. Pat. No. 2393530). "Fiberglas" is Reg. TM of Owens-Corning Fiberglas Corp.

TUNG-SOL



TUNG-SOL

5881

the beam power amplifier that embodies all the important improvements in electron tube design . . .

Available now in quantities

Absolute reliability!

There, in two words, is the net result of all the engineering which TUNG-SOL has put into the 5881. This completely new tube is designed to operate in circuits for which the 6L6 is specified and is completely interchangeable wherever the 6L6 is now in use. Full utilization of the design and production techniques which have proved themselves over the past 15 years, has created this exceptionally reliable tube. The 5881 has tremendous overload capacity. It maintains high efficiency throughout its life and provides low cost operation through reduced maintenance.

The 5881 is manufactured under laboratory conditions accompanied by the most severe tests. It is rugged both mechanically and electrically. Here are six major features which assure its premium performance:

1. Glass button stem permits compact construction with high resistance to mechanical shock.

2. Rugged micanol low-loss base provides full lifetime electrical insulation and minimizes base leakage.

3. Cathode materials of exceptional stability give more uniform emission with greater life expectancy. Cathode is not poisoned by inactivity during standby periods.

4. Maximum control of grid emission achieved by gold plating and carbonizing.

5. Zirconium anode coating is most active under overload conditions providing ample gettering action to prevent accumulation of gases.

6. Life tests are made under severe overload conditions to assure adequate safety factor.

Where reliable service is essential in audio circuits, the TUNG-SOL 5881 is a "must." Order it from your regular TUNG-SOL supplier.

MECHANICAL DATA

Envelope	Glass RMA T-11
Base	Short shell micanol
Overall length	3-15/32"
Seated height	2-29/32"
Maximum diameter	1-7/16"

ELECTRICAL DATA

Maximum Ratings—(Design Center System in accordance with RMA Standard MB-210)

Plate dissipation	23 WATTS
Screen dissipation	3 WATTS
Plate voltage	360 VOLTS
Screen voltage	270 VOLTS
Heater-cathode potential	200 VOLTS
Heater voltage	6.3 VOLTS

ELECTRICAL DATA

Typical Operating Conditions and Characteristics (Class A Amplifier)

Heater voltage	6.3	6.3	6.3	VOLTS
Heater current	0.9	0.9	0.9	AMP.
Plate voltage	250	300	350	VOLTS
Screen voltage	250	200	250	VOLTS
Grid voltage	−14	−12.5	−18	VOLTS
Peak A-F signal voltage	14	12.5	18	VOLTS
Transconductance	6100	5300	5200	μMHOS
Plate resistance	30000	35000	48000	OHMS
Zero signal plate current	75	48	53	MA.
Zero signal screen current	4.3	2.5	2.5	MA.
Maximum signal plate current	80	55	65	MA.
Maximum signal screen current	7.6	4.7	8.5	MA.
Load resistance	2500	4300	4200	OHMS
Power output	6.7	6.5	11.3	WATTS
Total harmonic distortion	10	11	13	%

The TUNG-SOL engineering which has produced the 5881 is constantly at work on a multitude of special electron tube developments for industry. Many exceptionally efficient general and special purpose tubes have resulted. Information about these and other types are available on request to TUNG-SOL Commercial Engineering Department.

TUNG-SOL ELECTRIC INC., NEWARK 4, NEW JERSEY

SALES OFFICES: ATLANTA · CHICAGO · CULVER CITY (CALIF.) · DALLAS · DENVER · DETROIT · NEWARK

TUNG-SOL MAKES ALL-GLASS SEALED BEAM LAMPS, MINIATURE LAMPS, SIGNAL FLASHERS, CATHODE RAY, RADIO, TV AND SPECIAL PURPOSE ELECTRON TUBES.

MARCH, 1952

For Dependable Electrical Protection...

RELY ON BUSS FUSES

Companion lines for FUSETRON and BUSS small dimension fuses are BUSS Fuse Clips, Blocks and Fuse holders. They are made in many types and sizes to make it easy to select the fuse and fuse mounting needed to give the required protection.

The complete line for
Television • Radio • Radar
Instruments • Controls • Avionics

Buss is the one source for any fuse you need: — standard type, dual-element (slow blowing), renewable and one-time types . . . in sizes from 1/500 ampere up.

Manufacturers and service men the country over have learned that they can depend on BUSS Fuses for dependable protection under all service conditions. The name BUSS has meant unquestioned high quality for more than 37 years.

To make sure that quality is always maintained, EVERY BUSS FUSE IS ELECTRONICALLY TESTED. The sensitive testing device rejects any fuse that is not correctly calibrated, properly constructed and right in all physical dimensions.

You can help protect your good-will and your reputation, when you standardize on BUSS Fuses.

If you have a special problem, let us help you select or design the right fuse or fuse mounting to meet your needs. Our staff of fuse engineers and research laboratory are at your service.

BUSSMANN MFG. CO. **St. Louis 7, Mo.**
Division of McGraw Electric Company

Manufacturers of a complete line of fuses for home, farm, commercial and industrial use.

SEND THE COUPON for Complete Facts

Bussmann Mfg. Co., University at Jefferson
St. Louis 7, Mo. (Division McGraw Electric Co.)

Please send me Bulletin SFB on BUSS Small Dimension Fuses and Fuse Holders.

*Name*_____

*Title*_____

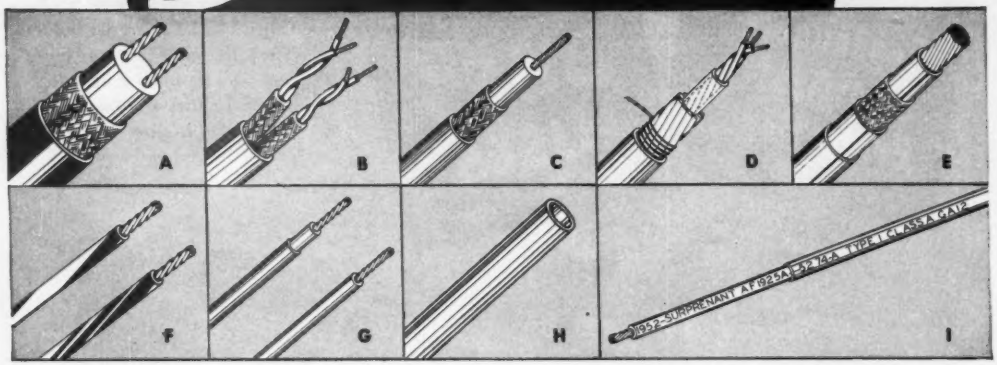
*Company*_____

*Address*_____

*City & Zone*_____ *State*_____ 352
ELSB

Surco WIRE · CABLES · TUBING

OPERATING TEMPERATURES FROM -60°C TO 200° C — SIZES FROM 32 TO 4/0



A **Coaxial Cables**—"Surco" coaxial cables include a wide variety of types, such as low capacity, extra flexibility, small diameter, microphone 2 conductor, and high temperature "Surflon". Conform to Military Spec. Jan-C-17A. Many special designs. If you have a coaxial cable problem consult us.

B **Miniature Wire & Cable**—"Surco" miniature wire and cables are made in conductor sizes down to No. 32 AWG in stranded and solid. Close control in manufacturing permits small finished diameters on both single and multi-conductor cable. Available in standard colors with and without nylon jacket or shielding in the various vinyl or polyethylene compounds.

C **"Surflon" (200°C) Hook-up Wire**—Capable of operation at 200°C for long periods with no appreciable decomposition. "Surflon" (tetrafluoroethylene) is non-inflammable and resistant to chemicals (has no known solvent). Adaptable for high frequency use because of low electrical losses. "Surflon" also has very high volume and surface resistivity. It is available in hook-up wire sizes with shield or jacket.

D **Multi-Conductor Cables**—"Surprenant" multi-conductor cables are available with conductor sizes from No. 32 AWG and larger, with or without nylon jacket or shielding and can be made to specification for special design and applications. Close tolerances permit unusually small overall diameters and "Spiralon" color coding permits easy identification even when hundreds of conductors are involved.

E **New Improved Aircraft Wire**—"Surprenant" sandwich construction (vinyl-glass braid-vinyl-nylon) gives excellent overload safety, high and low temperature performance and good electrical properties (made to conform to Military Spec. MIL-W-5086). Nylon jacketed, it has greater resistance to abrasion, fungus, moisture, hydraulic and other oils. "Surprenant" also offers nylon jacketed-polyvinyl-chloride construction made to conform to Military Spec. AN-J-C-48A.

F **"Spiralon"**—"Surco-Spiralon" color coding is available on all vinyl and polyethylene insulated wires, with or without nylon jackets. One, two, or three color stripes are available in the standard Nema colors providing almost unlimited color identifications.

Solid color insulation is also available in the 10 standard Nema colors.

G **"Surco" A-10 For (105°C) Hook-up Wire**—A-10 is an unusually high grade vinyl insulating compound developed in our own laboratories for a better hook-up wire. It has excellent resistance to deformation, soldering, high temperature, low temperature and aging; high electrical properties; Underwriters Lab. approved for continuous operation to 105°C without fibrous covering.

JAN-C-76 Hook-up Wire—Made to conform to Military Spec. (WL-SRIR-SRHV-SRRF) in all sizes. WL available with nylon jacket or glass braid. The nylon jacket has greater abrasion resistance and high surface resistivity under adverse conditions. SRIR-SRHV-SRRF available with primary insulation only or with the addition of a glass braided covering. All standard colors including "Spiralon" spiral striping.

H **"Surco" Tubing**—"Surco" vinyl tubing is available in special formulations to provide low temperature (-65°C), high temperature (U.L. approved for 105°C), high dielectric strength, flexibility and colors. Standard compounds are carried in stock in regular sizes. Polyethylene and nylon tubing are also available and are carried in stock in natural color in limited sizes. S-18-A conforms to 12047-A.

I **MIL-W-5274A Radar & Electronic Hook-up Wire**—Made to conform to Air Forces Spec., this wire offers excellent low temperature performance. Nylon jacketed, it has high abrasion resistance and superior surface resistivity even under adverse humidity conditions, making it very adaptable for high impedance circuits.

Surflene INSULATED HOOK-UP WIRE

"Surflene" Insulated Hook-up Wire—"Surflene" is extruded trifluorochlorethylene and is noted for its outstanding resistance to heat, abrasion, most chemicals, and fuming nitric acid. It has high dielectric strength and insulation resistance. It is especially adapted for small size hook-up wire for high temperature operation and for totally enclosed application. "Surflene" is available in thirteen solid colors to insure positive circuit identification. "Spiralon" colors not available as yet. Colors available at present are as follows: Red, orange, yellow, light green, dark green, blue, pink, gray, tan, black, brown, white, and clear.

See you at the IRE Convention March 3—6, Booths 401—402

Surprenant MANUFACTURING COMPANY

199 WASHINGTON STREET, BOSTON 8, MASS.

CYLINDRICAL
reflection-free

21 inch
245 sq. in.

the largest 21″ CRT available!

DU MONT

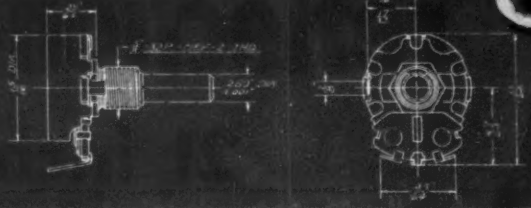
Cathode-ray Tube Division,
Allen B. Du Mont Laboratories, Inc.,
Clifton, N. J.

*Trade mark

A Complete Line

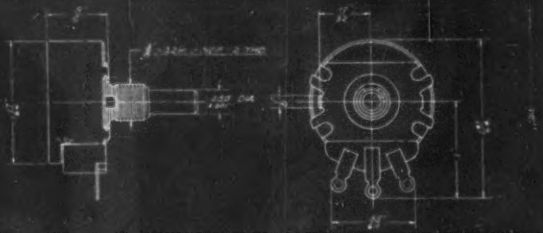
that

TYPE 45

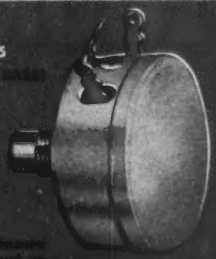


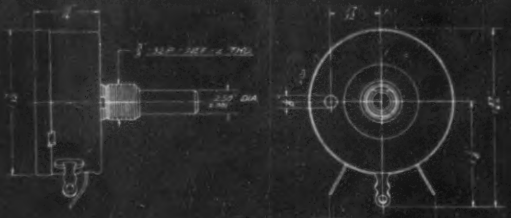
TYPE 35

TYPE 252



TYPE 25





For additional information on these 7 controls, write for Data Sheet No. 160.

EXCEPTIONALLY GOOD DELIVERY CYCLE on military orders due to enormous mass production facilities . . . *Immediate delivery from stock on more than 170 different types and resistance values . . .* Please give complete details on your requirements when writing or phoning for further information.

NEW COMPLETE CTS CATALOG. Write for your copy today.

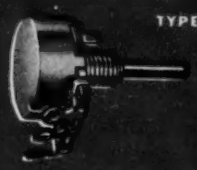
BURTON BROWNE ADVERTISING

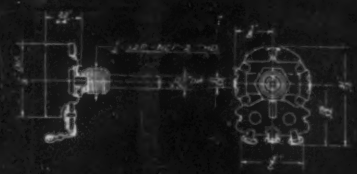
of Variable Resistors

MEETS MILITARY SPECIFICATIONS

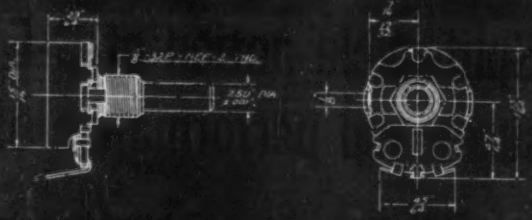
—55°C to + 150°C . . . complete aridity to saturation . . . are the unprecedented temperature and humidity ranges of Types 65, 90 and 95. These controls are used in military equipment subjected to extreme temperature and humidity.

TYPE 65

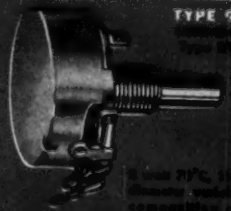


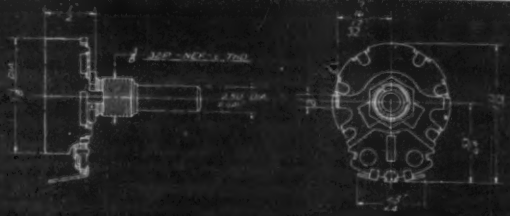


TYPE 90



TYPE 95





Specialists in Precision Mass Production of Variable Resistors

FOUNDED 1896

CHICAGO TELEPHONE SUPPLY *Corporation*

ELKHART • INDIANA

REPRESENTATIVES

Henry E. Sanders
401 North Broad Street
Philadelphia 8, Pennsylvania
Phone: Walnut 2-5369

W. S. Harman Company
1638 So. La Cienega Blvd.
Los Angeles 35, California
Phone: Bradshaw 2-3321

IN CANADA

G. C. Meredith & Co.
Streetsville, Ontario

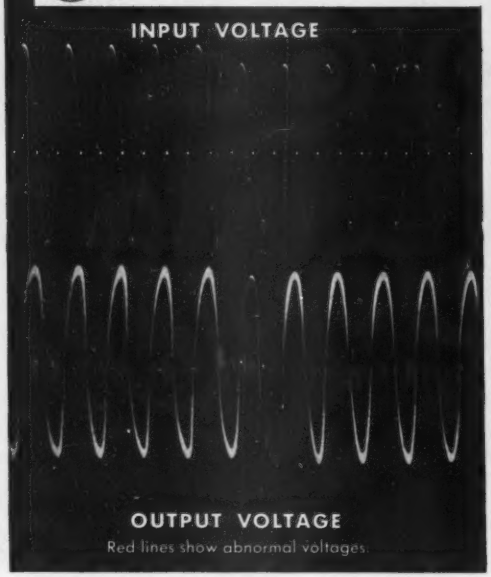
SOUTH AMERICA

Jose Luis Pontet
Buenos Aires, Argentina
Montevideo, Uruguay
Rio de Janeiro, Brazil
Sao Paulo, Brazil

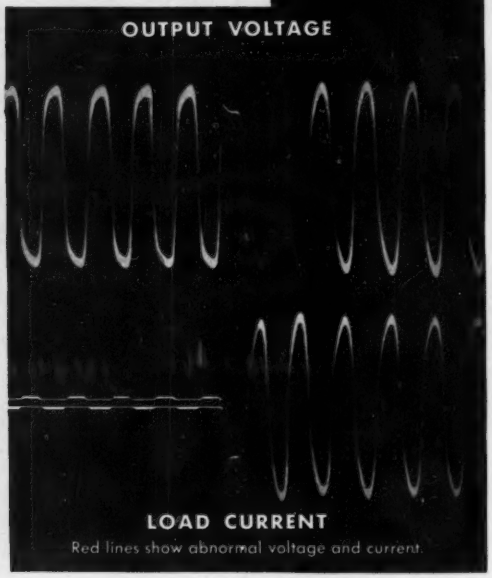
OTHER EXPORT

Sylvan Ginsbury
8 West 40th Street
New York 18, N. Y.

AUTOMATIC VOLTAGE STABILIZERS



Output voltage stabilized in less than one and one-half cycles as input drops from 130 to 100 volts.



Output voltage stabilized within two cycles as load current jumps from 0 to full load.

Split-cycle action of G-E Stabilizers assures top performance of your product

A common cause of substandard performance of electrical equipment is fluctuating a-c voltage supply. The simplest way to prevent local voltage conditions from affecting your product performance is to use G-E Automatic Voltage Stabilizers.

MADE TO FIT ANY APPLICATION

Light, compact, standard models are now made in sizes 15 to 5000 va. These models can easily be used in a wide variety of applications: laboratory and factory testing equipment, signal and alarm systems, and many others. To do specific jobs, special designs are available or can be made.

CORRECTS WIDE RANGE OF VOLTAGES

Standard G-E Voltage Stabilizers correct for all fluctuations between 95 and 130 volts, or 190 to 260 volts, delivering a stable 115 or 230 volts to your product within $\pm 1\%$. Special models can stabilize to an even closer degree.

EASY TO INSTALL; NO MAINTENANCE

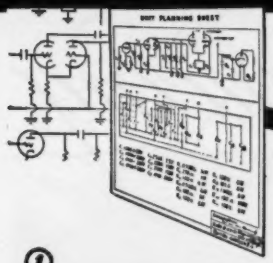
Only two sets of terminals to connect: one for supply and one for the load. Since there are no moving parts or electronic components, need for replacement parts, adjustments or any other maintenance is virtually non-existent. Operation is completely automatic. *General Electric Co., Schenectady 5, N. Y.*

SENSITIVE EQUIPMENT, such as this Type H Leak Detector, functions accurately only when voltage is properly stabilized. G-E voltage stabilizers perform this stabilizing function.

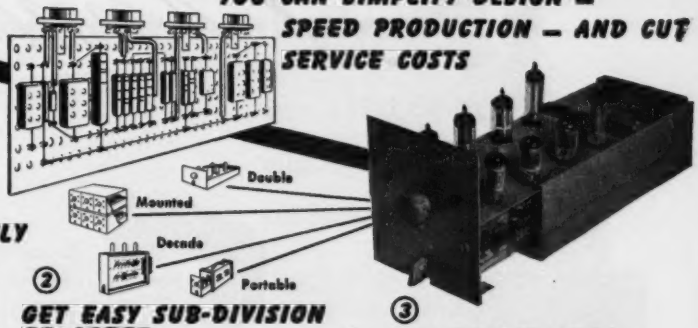
GENERAL ELECTRIC

411-99

BRING THROUGH EQUIPMENT FAST!



FROM STANDARD STOCK COMPONENTS YOU CAN SIMPLIFY DESIGN — SPEED PRODUCTION — AND CUT SERVICE COSTS



① **ORGANIZE CIRCUITS QUICKLY**

Schematics of most electronic equipment can be broken down into circuit blocks of logically associated functions. These functional circuit blocks can be mounted readily either in the Alden "20" plug-in packages or Basic Chassis unit. Tube sockets and associated components quickly lay out on full scale Unit Planning Sheets for mounting on terminal cards. These special pre-punched, multi-hole terminal cards have wide flexibility to take an infinite variety of circuit variations. Both sides of card can be used to obtain maximum component density area. Using the Unit Planning Sheets, functional circuit units are all planned in one step.

② **GET EASY SUB-DIVISION OF LABOR**

Solder terminals and sockets quickly rivet to Alden terminal card according to layout on Unit Planning Sheet. Components snap into the special Alden Miniature Terminals which hold them for soldering — (No twisting or wrapping of leads necessary) — With all tube sockets and their associated components mounted on one card — the wiring and soldering of circuits is an open, easy-to-work sub-assembly operation.

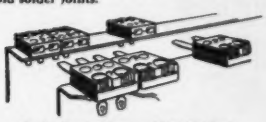
③ **CUT SERVICE AND MAINTENANCE COSTS IN FINAL EQUIPMENT**

In field, shop, or office your equipment maintenance is reduced to 30 second changeovers. Basic replacement elements are small enough in weight and size to be shipped by parcel post for repair.

IT'S AS SIMPLE AS THIS!

Miniature Terminals — 650 Series

Terminal cards have been designed to accommodate tremendous number of circuit variations — to make neat tube and component sub-assemblies with a minimum of wiring and simplified assembly techniques. Special Alden Miniature Terminals are new and radical punch press configuration — ratchet slot holds various size component leads for soldering — no twisting of leads with pliers. Figure "eight" shape accommodates cross wiring and buss leads. Terminals are punch press parts — so take a minimum of solder, reduce solder time, eliminate danger of cold solder joints.



Back Connectors — 462MIN Series

Alden Terminal Card System means minimum of inter-cabling — but even this cabling can be laid out easily and proceed as simple sub-assembly. Open sided chassis construction makes cable easy to wire to front panel, terminal cards and back connectors. The Alden Back Connectors are units that can be discretely positioned on the back of the chassis — isolating lines with incompatible voltages, currents, or frequencies. This design insures accessible solder terminals for soldering — avoids rat nests of congested conventional back connector wiring. Color coded, the Alden back connectors provide beautiful operational or service check points for all leads to and from chassis.

Hinged Front Panel Design

Hinged front panel design of chassis allows rheostats, indicator lights, jacks, etc. to be mounted on panel as another easy-to-work sub-assembly. This panel attaches easily to chassis — is wired — swung up and fastened with Alden Target Screws.

Target Screws

These screws have concave head with arced notch so power screw driver locates head quickly, no danger of it slipping out and marring panel surface — yet same screw can be unfastened with coin in order to hinge forward the front panel for servicing and check in the field.

"Serve-A-Unit Lock"

Assembled — the Basic Chassis simplifies operation of equipment — Slashes service and maintenance time. Smooth, positive insertion and removal of the chassis is provided by the Alden "Serve-A-Unit Lock." A simple twist of the handle and the chassis backs off with finger tip ease. It also pilots the chassis back into place — securely locking it for operation with the same facility.

TO GET STARTED QUICKLY!

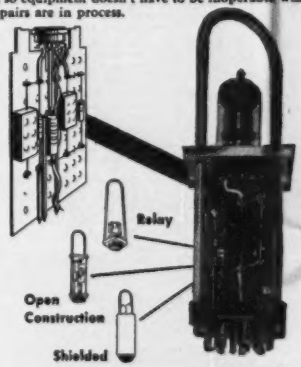
Wire for sample Basic Chassis at $40. — and Alden "20" Plug-in Packages at $10. — write Dept. B for booklet "Basic Chassis and Components for Plug-in Unit Construction."

SEE US AT BOOTH N3 THE IRE SHOW, GRAND CENTRAL PALACE, NEW YORK CITY

NA-ALD

FOR SMALLER UNITS ALDEN "20" PLUG-IN PACKAGES

Here is a plug-in package unit using the above method of converting schematic into finished assembly quickly. Simply mount the completed terminal card sub-assembly on the Alden "20" Non-Interchangeable base, dip solder the leads — add cover or housing and handle and it's completed — in operation, visual or instrument checks are easily made — if trouble occurs doubtful units are quickly isolated — these units easily unplug and a comprehensive inspection made. Spare units can be plugged in so equipment doesn't have to be inoperable while repairs are in process.



"20" Non-Interchangeable Base

"20" Rack and Chassis Mounting Sockets

ALDEN PRODUCTS COMPANY 127 North Main Street, Brockton, Massachusetts

Announcing

New York	William Gold Suite 7806, Empire State Bldg. New York City Phone—Longacre 4-2525
Boston	Henry P. Segel 143 Newbury Street Boston, Mass. Phone—Kenmore 6-3012
Baltimore Washington	James W. Houck Box 5844 Towson, Md. Phone—Towson 3114
Philadelphia	S. Victor Malta Box 205 Camden, N. J. Phone—Collingswood 5-5185W
Cleveland Pittsburgh Buffalo	Richard Snetsinger 1836 Euclid Avenue Cleveland, Ohio Phone—Main 1-4381
Detroit	Richard B. Harper 814 Fisher Building— Detroit, Mich. Phone—Trinity 1-4262
Cincinnati	M. L. (Marve) Williams 5720 Glengate Lane Cincinnati 13, Ohio Phone—Redwood 0284
Chicago Minneapolis	Dave Dolin 2635 S. Wabash Ave., Chicago 16, Ill. Phone—Calumet 5-2822
Los Angeles San Francisco	Jackson Edwards 2946 Belden Drive Los Angeles 28, Calif. Phone—Hudson 2-1133
St. Louis Kansas City	R. Harper 4356 Maryland Avenue St. Louis, Mo. Phone—Jefferson 6369
Dallas	Edward F. Aymond, Jr. 4308 Maple Ave., Dallas 9, Texas Phone—Logan 1970
Montreal	Harry Schwartz 145 Normand Street Montreal, Quebec Phone—Marquette 6736

This is YOUR plant!

SEALTRON'S new plant and general offices in Cincinnati, Ohio utilize the most advanced techniques and manufacturing methods ever conceived for the production of hermetic seals . . . to give you

IMMEDIATE DELIVERY
HIGHEST QUALITY
REALISTIC PRICES

25 sales representatives

for SEALTRON glass-to-metal hermetic seals

THE SEALTRON COMPANY

9701 READING ROAD • CINCINNATI 15, OHIO • TELEPHONE VALLEY 8500

SMALL, and

BIG...

HELDOR TERMINAL No. 187

small in size...BIG in application!

Now, at last, a SMALL yet rugged terminal that's the answer to space and performance problems of hermetically sealed components. Literally "peanut" in size (the smallest compression-type, hermetically-sealed bushing assembly on the market today), it can be depended upon to perform as well as any of its "big brothers".

If space is at a premium in your hermetically-sealed component design . . . and you want TOP PERFORMANCE . . . it will pay you to get complete data on the amazingly versatile HELDOR TERMINAL No. 187.

WRITE FOR DATA

Send Data on HELDOR Terminals #187
Name ..... Title .....
Company .....
Street .....
City..... Zone..... State.....

NEW! Watch for important announcements on Heldor's new #500 G and #875 BX bushing assemblies AND . . . the new Heldor Condenser Terminals made to pass JAN-C-25 specifications.

HELDOR BUSHING & TERMINAL CO., Inc.
225 Belleville Ave., Bloomfield, N. J.

PREFERRED SOURCE FOR QUALITY TOROIDS & FILTERS

For every "Burnell" toroid or filter specified in the bill of materials for Electronic equipment, we chalk up another credit for our "Burnell Customer Service."

In this highly specialized and technical field, individual attention to the customer's problem assures him of obtaining the best filter for his application. It is the job of our engineering sales department to thrash out every detail of the customer's problem until it is sure that the specifications will guarantee correct performance.

The next step would be to choose from our file of thousands of designs, one which meets the requirements. In many instances, of course, it is necessary to create an original design but *at no extra cost to the customer.* In either case, we can state unequivocally, that the result is invariably one of customer satisfaction. This is why Burnell has been the "preferred source" with so many engineers.

EXCLUSIVE MANUFACTURERS OF COMMUNICATIONS NETWORK COMPONENTS

Burnell & Company
YONKERS 2, NEW YORK

Need permanent magnets and expert magnet services?

Substantial supplies of Carboloy Alnico permanent magnets now available for most D.O.-rated applications

CARBOLOY magnet engineers are experts at designing assemblies with circuits that provide more useful energy with less magnetic material. Their services are yours when you need help in magnet design and application.

TWO helpful bulletins are yours for the asking: a clear, informative Permanent Magnet Design Manual with latest technical data, and the newly released catalog of Stocked Carboloy Alnico Permanent Magnets. Send coupon for your free copies.

Substantial, increasing quantities of Carboloy Alnico permanent magnets are now available to all plants that can extend their D.O. ratings under C.N.P. Regulation No. 3. For nearly all applications except toys, novelties and a few other accepted uses, you can plan to use magnets for modernization of present products, new products in the experimental stage or expanded production of present applications. Carboloy magnets are available in cast or sintered form . . . will be job-designed and built to your specifications or furnished from standard stocks.

And, as always, experienced Carboloy magnet engineers will assist you in magnet design and application. Their skills with Carboloy Alnico magnets may supply just the extra touch you need to help you improve that meter, motor, instrument, control, generator, magneto, TV speaker or whatever product you produce.

Guaranteed Energy

You'll get superior magnets, too. Carboloy magnets are built under the most rigid controls practiced anywhere. They are checked and tested for quality and uniformity, and each one is *guaranteed* to meet or surpass the industry's external energy minimum.

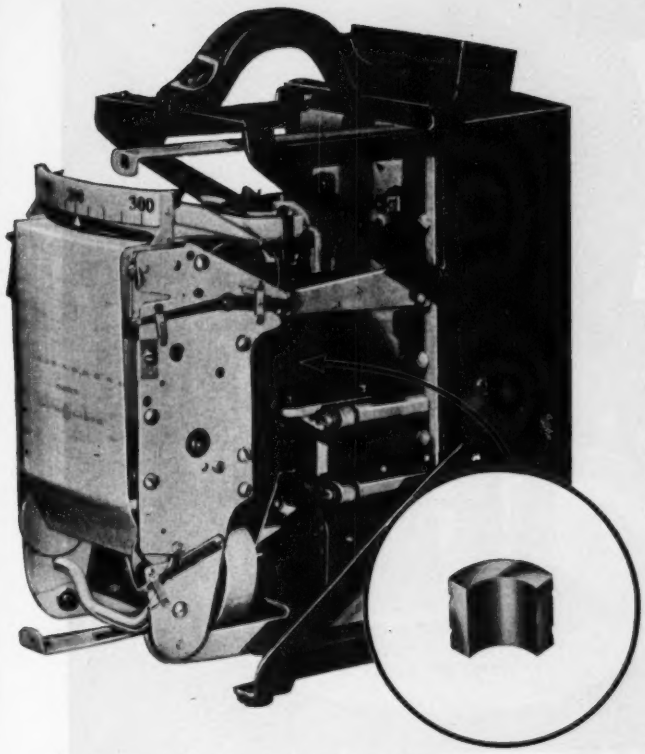
Get in touch with us today. From design to *delivery on the day promised,* we'll do everything possible to give you service and satisfaction . . . *plus* the magnets you need to make your products better, your profits greater.

"Carboloy" is the trademark for the products of Carboloy Department of General Electric Company

CARBOLOY

DEPARTMENT OF GENERAL ELECTRIC COMPANY

11139 East Eight Mile Road • Detroit 32, Michigan



METERS and instruments are but one of the many fields where permanent magnets work wonders. In the Current Recorder above, a concentric magnet element of Carboloy Alnico is the measuring mechanism. Being small in size, but tremendously powerful, it simplified the design . . . reduced the recorder's weight by 10 pounds . . . greatly contributed to its sensitivity and accuracy. Here is a typical case where modernization through permament magnets pays off in improved products.

GET THESE 12 OUTSTANDING ADVANTAGES! SPECIFY CARBOLOY PERMANENT MAGNETS

1 **SIMPLE**—Compact, self-containing sources of energy with no operating parts.

2 **UNIFORMLY POWERFUL**—Guaranteed to meet or surpass the standard external energy minimum.

3 **LAST FOREVER**—Will supply a constant, uniform magnetic field indefinitely.

4 **NO WIRING**—Eliminate need for coils, windings, or other electrical fixtures.

5 **COOL-RUNNING**—Won't generate heat; need no provisions for heat dissipation.

6 **NO OPERATING COSTS**—Operate without maintenance costs or any power supply.

7 **NO POWER FAILURES**—There is no outside source of power to fail!

8 **COMBINE ELECTRICAL AND MECHANICAL FEATURES**—Transform electrical energy into mechanical motion; mechanical motion to electrical energy.

9 **SIMPLIFY MECHANICAL ASSEMBLIES**—Exert strong tractive force for holding, lifting and separating devices that eliminates component parts, makes product design and fabrication extremely simple.

10 **UNINTERRUPTED OPERATION**—Magnetic energy flows *continually* and *forever!*

11 **CREATE SAVINGS**—Reduce weight, save space, lower cost of fabricating and eliminate other, often more costly, power-supplying parts.

12 **MOISTURE-RESISTANT**—No coils to collect moisture.

CARBOLOY

ALNICO PERMANENT MAGNETS

Designed Right . . . Built Right . . .
Delivered Right on Time
and with
Energy-Potential Right!

Clip and Mail Today!

CARBOLOY
Department of General Electric Company
11139 East Eight Mile Road, Detroit 32, Michigan

I am interested, without obligation, in receiving information about the 12 outstanding advantages of Carboloy Alnico Permanent Magnets.

☐ Send me free copies of Design Manual and Standard Stock Catalog.

☐ Have a Carboloy magnet engineer call at my plant soon.

Name_____ Position_____

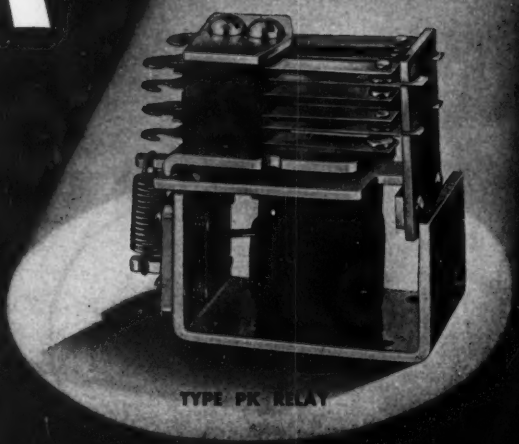
Company Name_____

Address_____

City_____ Zone____ State_____

PEAK

IN POWER VERSATILITY QUALITY PERFORMANCE



TYPE PK RELAY

HERE ARE THE FACTS AND FIGURES:

CONTACTS: 10 amp. standard. 24 volts D.C., 115 volts A.C.
15 amp. contacts available.

SENSITIVITY: D.C.: 4 pole 1.5 watts
2 pole .7 watts
A.C.: 4 pole 5 volt amperes
2 pole 2.5 volt amperes
Can also be furnished in 6 pole AC and DC up to 4000 Ohms.

COIL: To 115 volts D.C., 230 volts A.C.

NOMINAL HEAT RISE: D.C. 30°C above room ambient
A.C. 45°C above room ambient

MAX. INPUT FOR 85° RISE: D.C. 5 watts
A.C. 11 volt amperes

MOUNTING: Base or end mounting

WEIGHT: 4.5 oz. 4 P.D.T.

WEIGHT HERMETICALLY SEALED: 7.7 oz.

DIMENSIONS: Open Relay—2 1/16", 1 1/8", 2 1/16"
Sealed Relay—3 1/8", 1 1/2", 2 9/16"
Overall Mounting Flange—3 1/8"
Center to Center Mounting Holes—2 11/16"

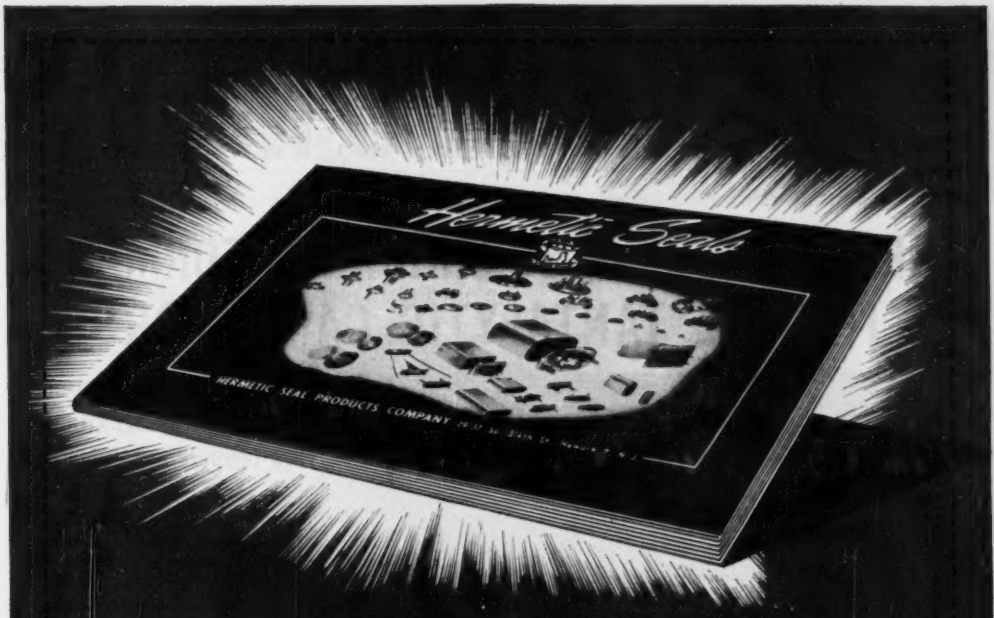
A Quality Relay

The new Allied PK Relay is designed to offer versatility in a power relay where quality and low cost are factors. Besides stability in operation its reliability allows a range in applications from high quality instruments to vending machines. The PKU relay will comply with Underwriters' Laboratories requirements and can also be supplied hermetically sealed.

Bulletin PK gives complete details. Send for your copy today.

Be sure to send for your copy of Allied's Relay Guide. It gives the engineering data for 17 Allied relays in a concise tabular form for easy reference.

ALLIED CONTROL COMPANY, INC. 2 EAST END AVENUE, NEW YORK 21, N.Y.



The Brochure You've Been Waiting For Is Off The Press!

Are you one of the thousands of electronic engineers who has already requested a copy of this important, new, 32 page brochure on hermetic sealing? If not, send your name in today for your FREE copy.

Nothing before has ever been done in this highly specialized field that can compare with this new presentation on glass-metal headers.

Beautifully printed in 3-colors, this brochure will bring you up to date on hermetic sealing, because it shows a remarkable exposition of what HERMETIC SEAL PRODUCTS CO. has achieved in miniature and sub-miniature plugs and seals, as well as in standard-size headers.

Years of creative, fruitful effort by HERMETIC have made it the largest exclusive manufacturer of hermetic seals in the world. This company has pioneered and introduced almost every important innovation in this most exacting field.

HERMETIC's specialist-engineers, with such a background, are eager to help you with your problems in the ever-expanding usage of hermetic sealing.

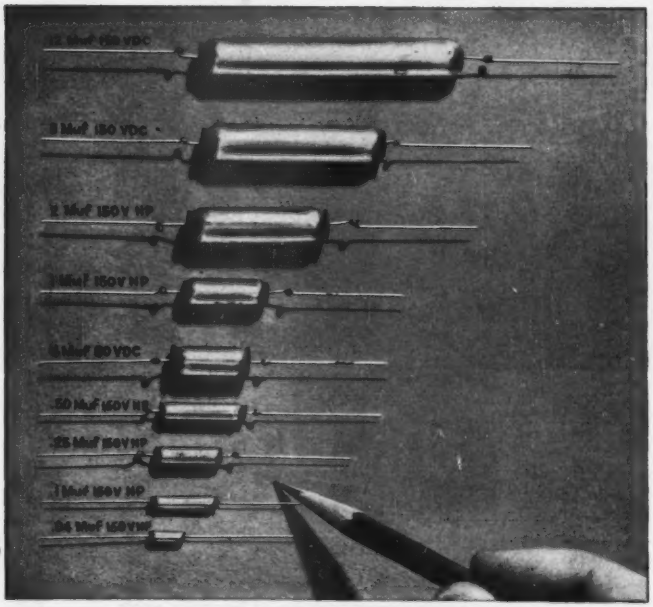
VISIT HERMETIC'S BOOTH NUMBER 129 AT THE 1952 I. R. E. SHOW.

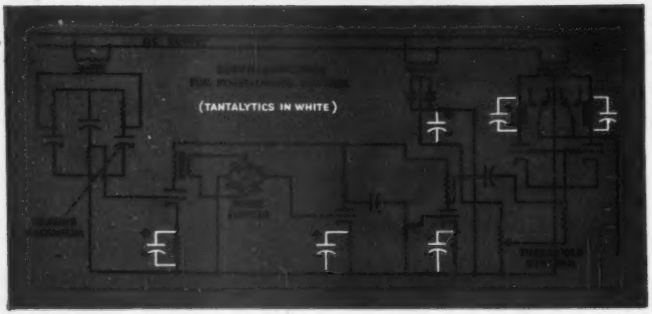
SEALED IN HERMETIC HEADERS

HERMETIC SEAL PRODUCTS CO.

DESIGNER'S

FOR SMALL SIZE, SUPERIOR PERFORMANCE IT'S G-E TANTALYTIC CAPACITORS





NEW tantalum-electrolyte units offer excellent low-temperature properties

Superior performance and large capacitance per unit volume make new General Electric Tantalytic capacitors valuable wherever miniaturization is a "must." Designed for low-voltage, direct-current applications, these capacitors excel in low-temperature properties and shock resistance.

Other advantages: Long shelf life • Exceedingly low leakage current • Hermetic sealing • Good stability • Chemically-neutral electrolyte

Operating temperatures range from −55C to +85C, ratings from .02 muf to 12 muf at 150 volts d-c. For further data, send coupon for Bulletin GEA-5753. For specific applications, list temperature range, leakage resistance values, and operating voltage and write *Capacitor Sales Division, General Electric Co., Hudson Falls, N. Y.*

For example: on this gun control system—

Design specifications for the circuit of a gun control servo-amplifier system required capacitors with great stability over a wide temperature range. Airborne equipment was involved, so size and weight were also extremely important. G-E Application Engineers were called in while the design was still on the board. Tantalytic capacitors were recommended because they are small, light, chemically stable. Result: a finished design that meets every requirement.

GENERAL ELECTRIC

667-19

DIGEST

TIMELY HIGHLIGHTS ON G-E COMPONENTS

FOR RELIABLE DC TO AC AMPLIFICATION

NEW Second Harmonic Converter

The new G-E second harmonic converter is a magnetic-amplifier-type unit which converts low-level d-c error signals (such as those generated by thermocouples) to double-frequency AC. Developed for exhaust gas temperature control of jet engines, it's also applicable to control approach systems, industrial measurements, computing devices, and numerous servo mechanisms and electronic control systems.

Designed for use on 400-cycle power (800-cycle output) the converter can be adapted for use on other frequencies by selecting the proper external capacitance. Reliability and long life result from these features: hermetic sealing, static operation, low temperature rise. Write now for full details in Bulletin GEC-832. Then, if you have an application, contact your General Electric Apparatus Representative.

(Actual Size)

ANTI-BREAKDOWN PROTECTION

NEW Hermetically-Sealed Relay

General Electric's new hermetically-sealed aircraft relay for operation in exposed locations features extra protection against permanent breakdown due to voltage surges. Special polyster compound used to mold contact arms into the stack insulation is non-tracking, provides greater arc resistance. More powerful magnet structure yields higher tip pressures for surety of make. Rated 28 volts d-c, 3 amp. See Bulletin GEA-5729.

125 DEVICES DESCRIBED

NEW Measuring Equipment Catalog

G-E's complete line of measuring equipment for laboratory and production testing is concisely described in this new 80-page reference catalog. Measuring and testing devices include photovoltaic cells, time meters, the current-limited high-potential tester, and dozens of other products. Prices, application information, and condensed tables of important characteristics are all given in this illustrated booklet. Check Bulletin GEC-1016.

EQUIPMENT FOR ELECTRONIC MANUFACTURERS

A partial list of the thousands of items in the complete G-E line. We'll tell you about them each month on these pages.

Components

Meters and instruments	Timers
Capacitors	Indicating lights
Transformers	Control switches
Pulse-forming networks	Generators
Delay lines	Selsynes
Reactors	Relays
*Thyrite	Amplidynes
Motor-generator sets	Amplistats
Inductrols	Terminal boards
Resistors	Push buttons
Voltage stabilizers	Photovoltaic cells
Fractional-hp motors	Glass bushings
Rectifiers	Dynamotors

Development and Production Equipment

Soldering irons
Resistance-welding control
Current-limited high-potential tester
Insulation testers
Vacuum-tube voltmeter
Photoelectric recorders
Demagnetizers

*Reg. Trade-mark of General Electric Co.

General Electric Company, Section A667-19
Schenectady 5, New York

Please send me the following bulletins:

Indicate: √ for reference only
× for planning an immediate project

( ) GEA-5729 Hermetically Sealed Relays
( ) GEA-5753 Tantalytic Capacitors
( ) GEC-832 Second Harmonic Converters
( ) GEC-1016 Measuring Equipment

Name.....

Company.....

Address.....

City.....State.....

Military reconnaissance men know the value of the "intelligence reports" faithfully rendered by these Veeder-Root Distance and Topography Counters. And other men, who have to do the close figuring in other arms of the service, they too count on Veeder-Root Counters in more ways than you could shake a "slip-stick" at.

Now if we can help *you* to help these men, by figuring out some new and unusual application of Veeder-Root *Count*rol in defense production, then you can count us at your service, *beginning right now.*

VEEDER-ROOT INCORPORATED

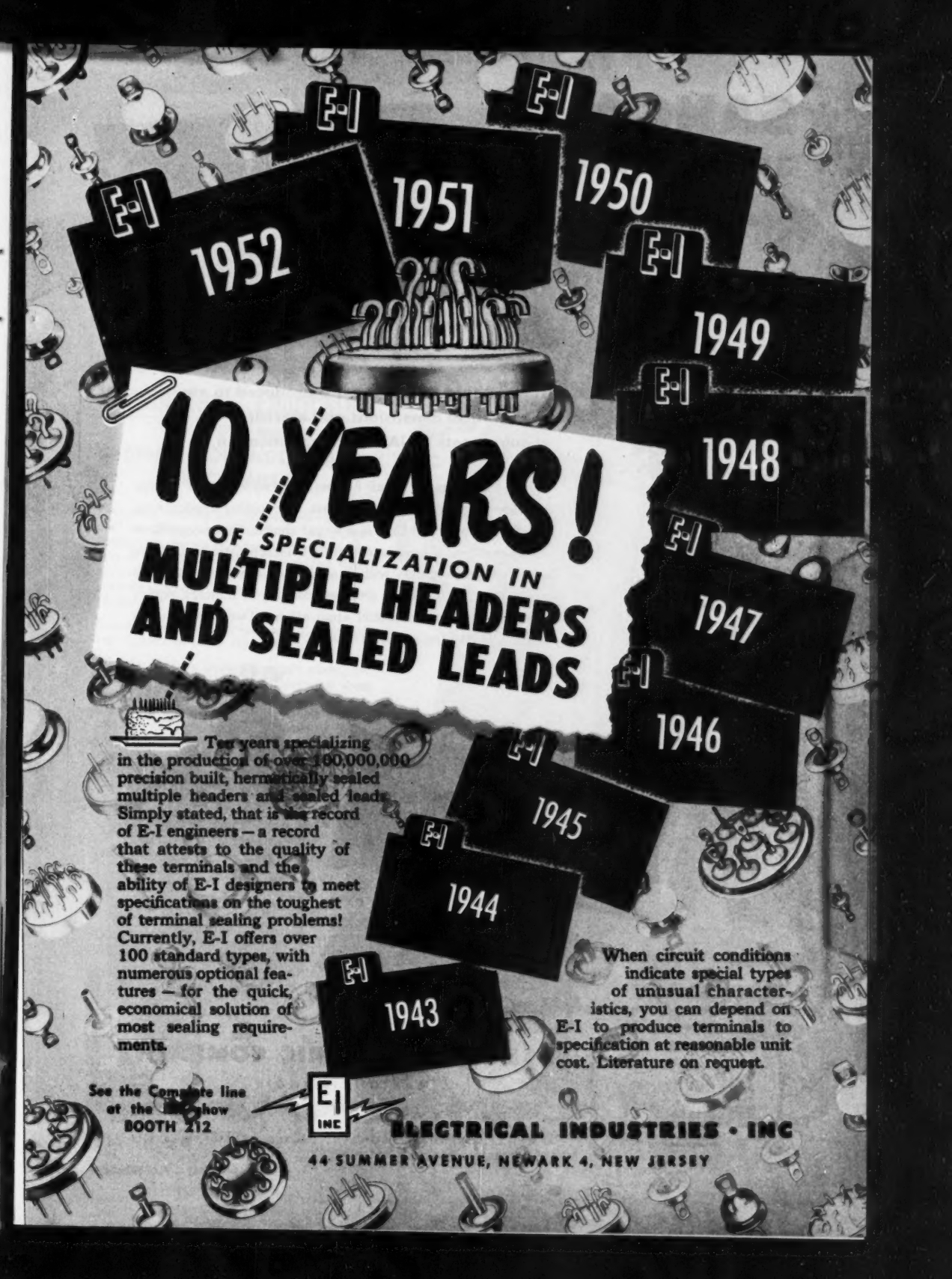
"The Name That Counts"

HARTFORD 2, CONN. • GREENVILLE, S. C.

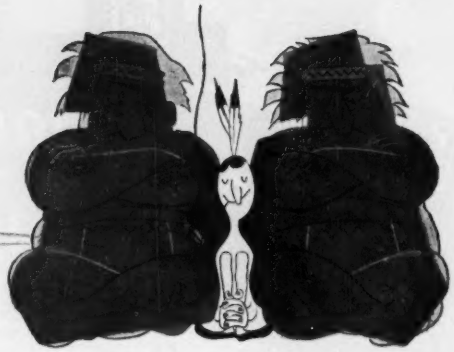
Montreal 2, Canada • Dundee, Scotland

Offices and agents in principal cities

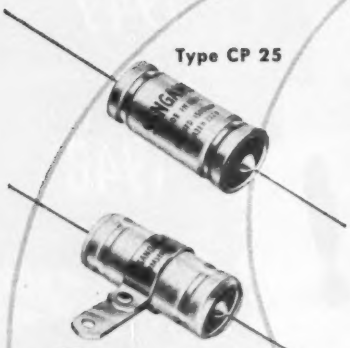
"Counts Everything on Earth"


E-I
1952
E-I
1951
E-I
1950
E-I
1949
E-I
1948
E-I
1947
E-I
1946
E-I
1945
E-I
1944
E-I
1943
10 YEARS!
OF SPECIALIZATION IN
MULTIPLE HEADERS
AND SEALED LEADS
Ten years specializing in the production of over 100,000,000 precision built, hermetically sealed multiple headers and sealed leads. Simply stated, that is the record of E-I engineers — a record that attests to the quality of these terminals and the ability of E-I designers to meet specifications on the toughest of terminal sealing problems! Currently, E-I offers over 100 standard types, with numerous optional features — for the quick, economical solution of most sealing requirements.
When circuit conditions indicate special types of unusual characteristics, you can depend on E-I to produce terminals to specification at reasonable unit cost. Literature on request.
See the Complete line at the Show
BOOTH 212
EI INC
ELECTRICAL INDUSTRIES • INC
44 SUMMER AVENUE, NEWARK 4, NEW JERSEY

SANGAMO
Paper Capacitors
"Fit in tight Spots!"



Type CP 25



Type CP 28

Type CP 40

Here is a compact high voltage filter capacitor, designed to conserve space. Type 40 is Diaclor* impregnated and filled and mounts easily to the chassis.

These Paper Can Types are produced to meet the physical dimensions and electrical requirements of JAN-C-25 specification.

Where exceptionally small hermetically sealed paper capacitors are required for filter, by-pass, or coupling applications, the Sangamo CP 20 Line is a sound choice. These capacitors are mineral oil impregnated for E Characteristic and assure excellent performance with long life at temperatures from − 55° to + 85° C. They are ideal for use in military equipment, aircraft, or industrial applications. Two typical units of the CP 20 Line are illustrated at left.

All approved for Armed Services Applications

Type CP 70

A fabricated can type, Diaclor* filled, power supply paper capacitor. Excellent for use in transmitting apparatus, portable communications equipment, sonar or radar sets, and ground control approach equipment.

*Trade Mark Registered. (Chlorinated dielectric oil)

Your Assurance of Dependable Performance

SANGAMO ELECTRIC COMPANY

MARION, ILLINOIS

IN CANADA, SANGAMO COMPANY LIMITED, LEASIDE, ONTARIO

Bottle Neck Buster!

...KARP "Accurated" Fabrication

OF SHEET METAL CABINETS, HOUSINGS, CHASSIS, ENCLOSURES

Production is rolling and costs stay down in hundreds of plants, thanks to *KARP "Accurated" Fabrication*. Here is insurance that every dimension is accurate . . . every hole drilled clean, correctly sized and positioned . . . openings accurately spaced . . . all units uniform, and finish perfect.

That adds up to smooth, fast assembly that ends lost motion and builds volume output!

Why not let Karp Design Engineers study your assembly requirements for a fabricated sheet metal unit? Whether it's a liberal or close-tolerance job—whether it calls for simple or intricate forming, drawing, bending, welding, finishing, or all combined . . . *"Accurated" Fabrication* the Karp way *means real insurance of assembly ease, speed, and economy.* Send us your blueprints.

**Jobs are rated for required tolerances—liberal or close—with quality maintained at its best.*

SEE US AT THE I. R. E. SHOW BOOTHS 49-50

K
INDUSTRY'S PARTNER IN PRODUCTION

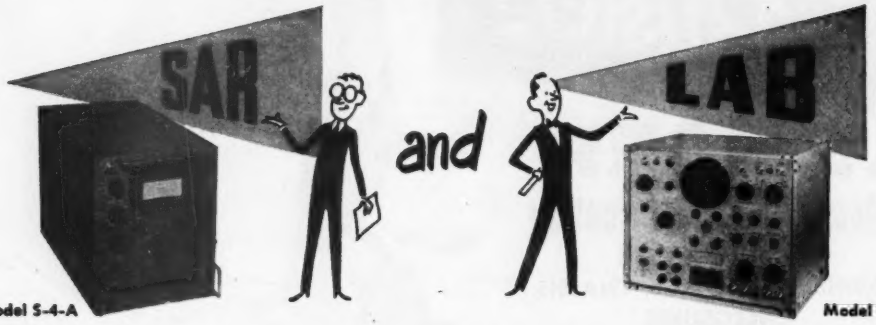
(Although Karp's big new plant is primarily engaged in production for major defense contractors and strategic materials are on allocation, we continue to the best of our ability to produce for general industry.)

KARP METAL PRODUCTS CO., INC.

215 63rd STREET, BROOKLYN 20, NEW YORK

Specialists in Fabricating Sheet Metal for Industry

PULSESCOPE®



Model S-4-A

Model S-5-A

PULSESCOPES are Oscilloscopes to portray the attributes of the pulse: such as shape, amplitude, duration and time displacement. Both of the PULSESCOPES have Video amplifiers with frequency response up to 11 megacycles with Video delay of 0.55 microseconds and pulse rise and fall time better than 0.07 microseconds.

S-4-A SAR PULSESCOPE—Video Sensitivity 0.5vp to p/in. S Sweep 80 cycles to 800KC, either trigger or repetitive. A Sweep 1.2 microseconds to 12,000 microseconds. R Delay 3 microseconds to 10,000 microseconds directly calibrated on precision dial. R Pedestal (or Sweep) 2.4 microseconds to 24 microseconds. Internal Crystal Markers 10 microseconds and 50 microseconds. Size 9⅛ x 11¼ x 17¼". Weight: Less than 32 pounds.

S-5-A LAB PULSESCOPE—Video Sensitivity 0.1vp to p/in. Sweep 1.2 microseconds to 120,000 microseconds with 10 to 1 expansion. Sweep either trigger or repetitive. Internal Markers synchronized with Sweep from 0.2 microseconds to 500 microseconds. Trigger Generator and built-in precision amplitude calibrator. Completely cased. Size: 16½ x 14⅛ x 14½". Weight: Less than 60 pounds.

WATERMAN RAYONIC TUBE DEVELOPMENTS

3 SP

Since the introduction of Waterman RAYONIC 3MP1 tube for miniaturized oscilloscopes, Waterman has developed a rectangular tube for multi-trace oscilloscopy. Identified as the Waterman RAYONIC 3SP, it is available in P1, P2, P7 and P11 screen phosphors. The face of the tube is 1½" x 3" and the over-all length is 9¼". Its unique design permits two 3SP tubes to occupy the same space as a single 3" round tube, a feature which is utilized in the S-15-A TWIN-TUBE POCKETSCOPE. On a standard 19" relay rack, it is possible to mount up to ten 3SP tubes with sufficient clearances for rack requirements. All RAYONIC cathode ray tubes are available in P1, P2, P7 and P11 phosphors. We are authorized to supply 3SP1, 3JP1 and 3JP7 with JAN stamp. All RAYONIC tubes listed below operate on 6.3 volts heater with .6 amp. current.

3 MP

TUBE	PHYSICAL DATA			TYPICAL VOLTAGES				DEFLECTION FACTOR V/IN.		MAX. VOLTS	
	Face	Length	Base	Anode #3	Anode #2	Anode #1	Grid #1	D1 to D2	D3 to D4	Anode #3	Anode #2
3JP	3 inch Round	10 inches	Medium Diheptal 12 Pin	3000	1500	300 to 515	−22.5 to −67.5	127 to 173	94 to 128	4000	3000
				4000	2000	400 to 690	−30 to −90	170 to 230	125 to 170		
3MP	3 inch Round	8 inches	Small Duodecal 12 Pin		1000	200 to 350	0 to −68	140 to 190	130 to 180		2500
					2000	400 to 700	0 to −126	280 to 380	260 to 360		
3SP	1½ x 3 inches	9.12 inches	Small Duodecal 12 Pin		1000	165 to 310	−28.5 to −67.5	73 to 99	52 to 70		2750
					2000	330 to 620	−58 to −135	146 to 198	104 to 140		

IRE SHOW, MARCH 3rd THRU 6th AT BOOTH 29

THE WATERMAN LINE-UP

POCKETSCOPE®

HI, WIDE and HANDSOME POCKETSCOPES are characterized by small size, light weight, and outstanding electrical performance. All units have frequency compensated attenuators as well as non-frequency discriminating gain controls. All units have both periodic and trigger sweeps from ½ cycle to 50KC. The amplifiers are direct coupled thus frequency response starts from 0 cycles. No peaking coils are used, thus, the transient response is good. Full expansion of trace, both vertical and horizontal, is built in. Means for amplitude calibration are provided. DC coupling in POCKETSCOPES provides unusual stability of the trace, regardless of the line voltage changes or variations of impedances in the input circuit. The HI, WIDE and HANDSOME POCKETSCOPES are the outgrowth of Waterman pioneering of the first commercial miniature oscilloscope, which has proved to be useful and reliable over a period of years. Combination filter and graph screens are used for better visibility, thus traces can be observed even under high ambient light conditions. Binding posts for convenience of connections, with an effective shield, are used. S-14-A has sensitivity of 10 mv/inch with pass band above 200KC. S-14-B has sensitivity of 50 mv/inch with pass band above 1 megacycle. S-15-A is similar to S-14-A except that it has two independent CR Tubes for multi-trace oscilloscope work. Accessories such as carrying cases and probes are available.

S-11-A

The Model S-11-A Industrial & Television POCKETSCOPE is a small, compact, lightweight instrument for observation of repetitive electrical circuit phenomena. The Industrial & Television POCKETSCOPE is a complete cathode ray oscilloscope incorporating the cathode ray tube, vertical, horizontal, and intensity amplifiers, linear time base oscillator, blanking, synchronization means and self-contained power supply. The Industrial & Television POCKETSCOPE can be used, not only for AC measurements, but for DC as well, inasmuch as it has vertical and horizontal amplifiers which are capable of reproducing faithfully within —2 db, from 0 to 200KC. The sensitivity of the vertical and horizontal amplifiers is high and is in the order of 100 mv rms/in.

S-12-B

Model S-12-B RAKSCOPE has the features of S-11-A POCKETSCOPE, plus. The RAKSCOPE is JANized and the government model number is OS-11. The Sweep, from 5 cycles to 50KC is either repetitive or triggered. Vertical and horizontal amplifiers are 50 millivolts rms per inch with band pass from 0 to 200KC. Special calibrating circuitry is provided for frequency comparison. Both the vertical and horizontal amplifiers are identical and use no peaking. The panel is only 7″ high and the scope fits standard rack. The functional layout of the control permits ease of operation.

WATERMAN PRODUCTS

WATERMAN PRODUCTS CO., INC.

PHILADELPHIA 25, PENNA., U.S.A.

CABLE ADDRESS, POKETSCOPE, PHILA.

Manufacturers of POCKETSCOPES® • RAKSCOPES® • PULSESCOPES® and RAYONIC TUBES®

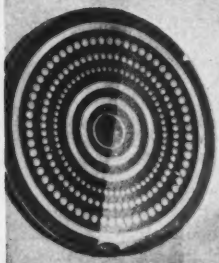
This is the Hallmark of the Ideal Insulation

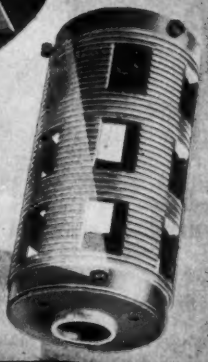
SINCE 1919

MYCALEX

THE INSULATOR

TRADE MARK REG. U.S. PAT. OFF.





FOR ALL FREQUENCIES

Mycalex, the ideal insulation, offers low loss and high dielectric strength. It is impervious to oil or water, free from carbonization, withstands high temperature and humidity. Mycalex remains dimensionally stable permanently and possesses excellent mechanical characteristics. In its present high state of development, Mycalex combines every important insulating advantage — including economy. Mycalex is available in sheets and rods, can be injection or compression molded to close tolerance, is readily machineable, can be tapped, drilled, threaded and ground.

INJECTION MOLDED GRADES

MYCALEX 410

Mycalex 410 is approved fully as Grade L-4B under National Military Establishment Specification JAN-I-10 "Insulating Materials, Ceramics, Radio, Class L."

Power Factor, 1 megacycle	0.0015
Dielectric Constant, 1 megacycle	9.2
Loss Factor, 1 megacycle	0.014
Dielectric Strength, volts/mil	400
Volume Resistivity, ohm-cm	$1x10^{15}$
Max. Safe Operating Temp., °C	350
Water Absorption, % in 24 hours	nil
Tensile Strength, psi	6000

MYCALEX 410X

Power Factor, 1 megacycle	0.012
Dielectric Constant, 1 megacycle	6.9
Loss factor, 1 megacycle	0.084
Dielectric Strength, volts/mil	400
Volume Resistivity, ohm-cm	$5x10^{14}$
Max. Safe Operating Temp., °C	350
Water Absorption, % in 24 hours	nil
Tensile Strength, psi	6000

Mycalex 410X can be injection molded, with or without metal inserts, to extremely close tolerances.

MACHINEABLE GRADES

MYCALEX 400

Mycalex 400 is approved fully as Grade L-4A under National Military Establishment Specification JAN-I-10 "Insulating Materials, Ceramics, Radio, Class L."

Power Factor, 1 megacycle	0.0018
Dielectric Constant, 1 megacycle	7.4
Loss Factor, 1 megacycle	0.013
Dielectric Strength, volts/mil	500
Volume Resistivity, ohm-cm	$2x10^{15}$
Arc Resistance, seconds	300
Max. Safe Operating Temp., °C	370
Water Absorption, % in 24 hours	nil
Tensile Strength, psi	6000

MYCALEX K-10

Dielectric Constant, 1 megacycle	10.6
Q Factor, 1 megacycle	300
Loss Factor, 1 megacycle	0.034
Dielectric Strength, volts/mil (0.10 in. thickness)	270
Fractional Decrease of Capacitance with Temperature Change	0.0056
Fractional Increase of Capacitance with Temperature Change	0.0076

Mycalex K-10 conforms fully to Grade HiC5H4 under National Military Establishment Specification JAN-I-12.

LOW-LOSS MINIATURE TUBE SOCKETS

ECONOMICAL — Comparative in cost to ordinary phenolic sockets, but far superior electrically. Dimensional accuracy unexcelled.

AVAILABLE IN TWO GRADES — Mycalex 410 fully approved as Grade L-4B under N.M.E.S. JAN-I-10 "Insulating Materials, Ceramics, Radio, Class L." Mycalex 410X offers lower cost with insulating properties exceeding those of general purpose phenolics. Both Mycalex 410 and 410X Tube Sockets are supplied in 7 pin, 9 pin and subminiature. All are precision molded for highest accuracy.

WRITE TODAY ON YOUR LETTERHEAD FOR ILLUSTRATED LITERATURE, OR SEND BLUEPRINTS FOR ESTIMATES — NO OBLIGATION

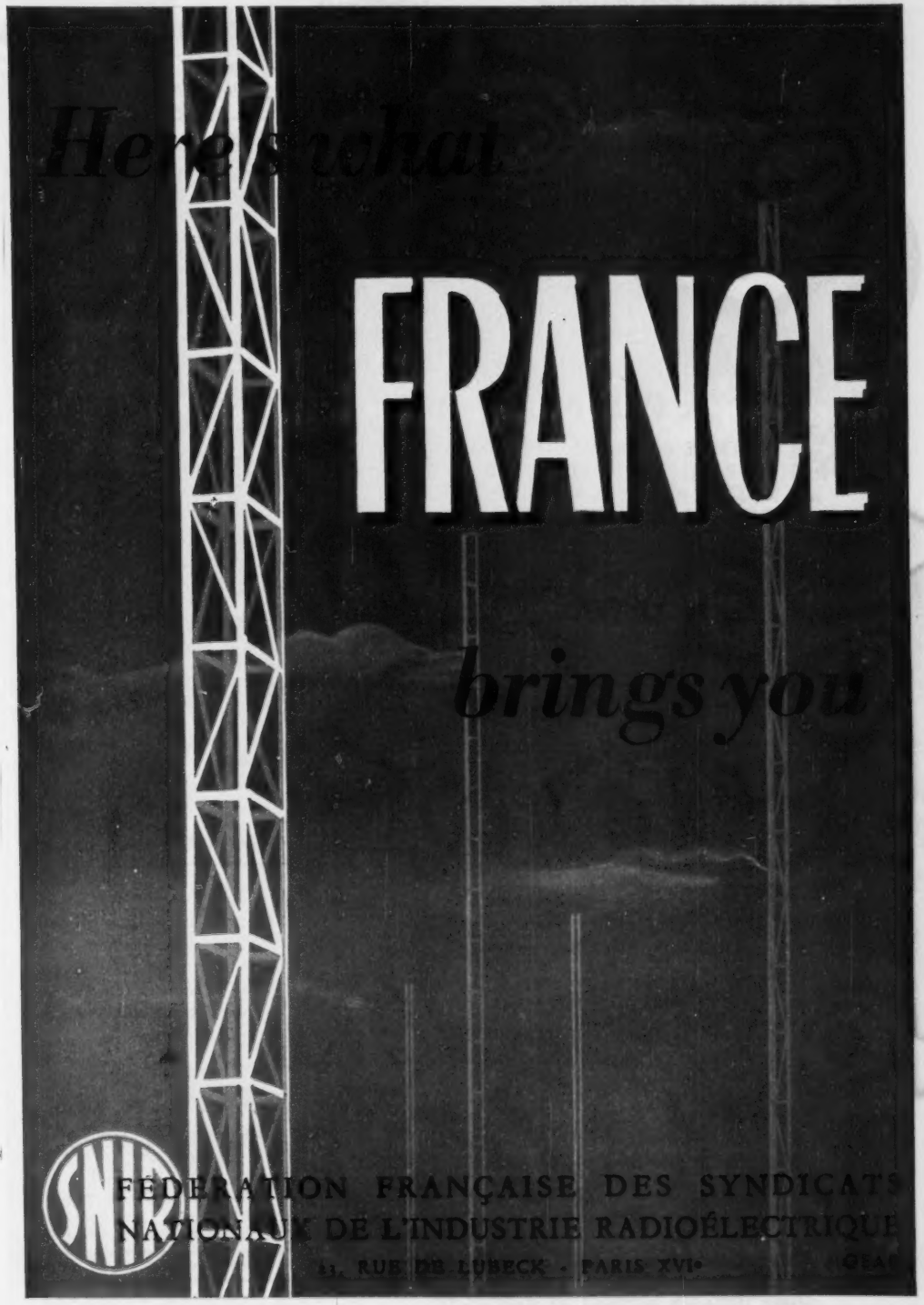
MYCALEX K

embraces an entire series of capacitor dielectrics, each with specific characteristics. These can be supplied on special order in sheets 14"x18" in area and from ⅛" to 1" in thickness, also available in rods. MYCALEX K can be machined to close tolerance or molded.

MYCALEX CORPORATION OF AMERICA

Owners of 'MYCALEX' Patents and Trade-Marks

Executive Offices: 30 ROCKEFELLER PLAZA, NEW YORK 20 — Plant & General Offices: CLIFTON, N. J.


Here's what
FRANCE
brings you
FÉDÉRATION FRANÇAISE DES SYNDICATS
NATIONAUX DE L'INDUSTRIE RADIOÉLECTRIQUE
11, RUE DE LUBECK - PARIS XVIe

ARENA - AUDAX - SAFCO-TREVOUX VEDOVELLI

THE Big Four FRENCH RADIO MANUFACTURERS GUARANTEE

★ MASS PRODUCTION
★ ATTRACTIVE PRICES
★ HIGHEST STANDARDIZED QUALITY
★ RELIABLE ON TIME DELIVERY

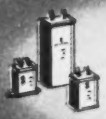
ARENA

ALL TYPES OF VARIABLE CONDENSERS FOR RADIO BROADCASTING AND ALL ELECTRONICS APPLICATIONS BY THE GREATEST PRODUCTION IN EUROPE

AUDAX

ALL TYPES OF LOUDSPEAKERS BY THE MOST IMPORTANT PRODUCTION ON THE CONTINENT

SAFCO-TREVOUX



CAPACITORS OF ALL TYPES BY THE MOST IMPORTANT SPECIALIZED PLANTS ON THE CONTINENT

VEDOVELLI

TRANSFORMERS AND COILS FOR RADIO - T.V. AND ALL ELECTRONICS AND INDUSTRIAL APPLICATIONS

DEAL WITH THEIR

SIEMAR

EXCLUSIVE EXPORT DEPARTMENT

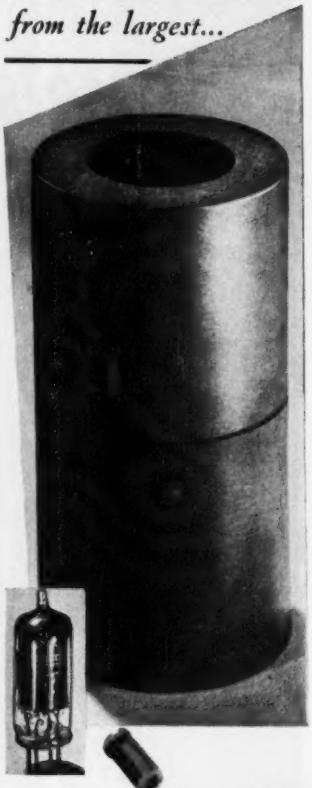
62, RUE DE ROME, PARIS-8e - TEL. LAB. 00-76

ARENA - AUDAX - SAFCO-TREVOUX - VEDOVELLI

MEMBER FEDERATION NATIONALE DES SYNDICATS DES INDUSTRIES RADIOELECTRIQUES ET ELECTRONIQUES

MAGNETIC CIRCUITS

from the largest...



to the smallest.

More than 2,000 types of cores, screws, pulleys, closed and perforated pots and other forms in sintered magnetic powder to meet all requirements from Low Frequency to very High Frequency.
Technical details on request

SOCIETE OMEGA

106, Rue de la Jarry, Paris-Vincennes.
Telephone: DAUmesnil 43-20

FACTORIES: PARIS and LYONS

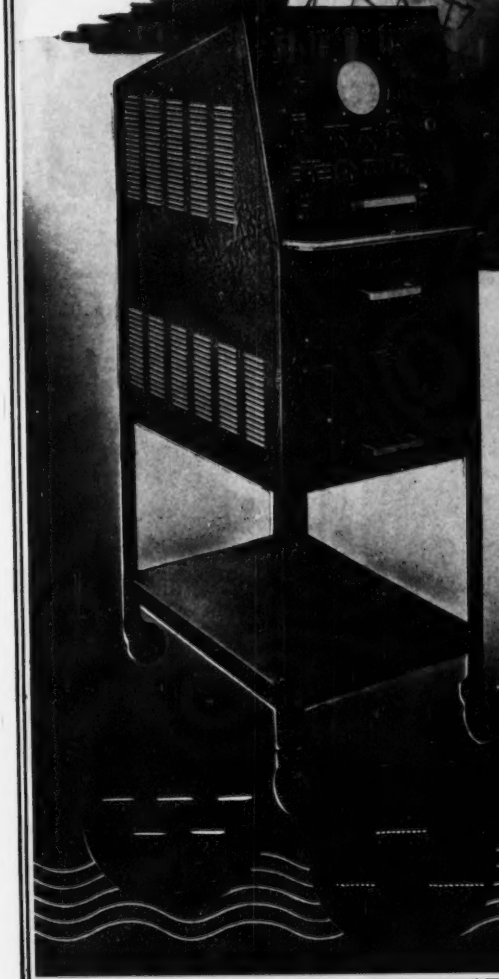
Sj. A member of the Federation S. N. I. R.

MESURE R D CONTROLE

RIBET-DESJARDINS

13, RUE PÉRIER • PARIS-MONTROUGE • FRANCE

THE ...OPEAN PR...
...F ELECTRO... ...IPMENT ...



...oscil-
... oscilloscope
...ce oscilloscope
...ower supply
...e signal generator

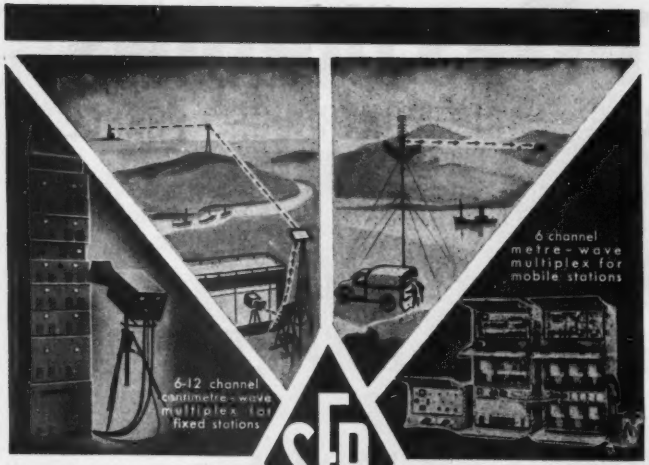
FOR RADIO AND TELEVISION

H-F and L-F generator
Television wobbulator
Modulated H-F generator

FOR INDUSTRY

Vibration measuring equipment
Pressure measuring device
Five-trace oscilloscope
Control devices
Magnetic comparator
Megohmmeter

MEMBER FEDERATION NATIONALE DES SYNDICATS DES INDUSTRIES RADIOELECTRIQUES ET ELECTRONIQUES



MULTI-CHANNEL
RADIO-LINK
EQUIPMENT

from 6 to 60 simultaneous
radio-telephone
communications

1947
Franco-Corsican
submarine cable

PUBL. RAPY

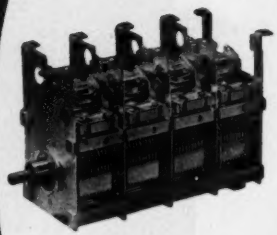
SOCIÉTÉ FRANÇAISE
RADIOÉLECTRIQUE

79, BOULd HAUSSMANN - PARIS 8e Tél. : ANJOU 84-60
USINES A LEVALLOIS-PERRET, CHOLET, ALGER, AGENCE A DAKAR

MEMBER FEDERATION NATIONALE DES SYNDICATS DES
INDUSTRIES RADIOELECTRIQUES ET ELECTRONIQUES

GENERAL
AND SPECIAL
PURPOSES
CONDENSERS

MASS
PRODUCTION



SPECIAL
DESIGNS
ON REQUEST

ALL STANDARD TYPES
FOR RADIO, TV
AND BROADCASTING

ELVECO
PARIS

70, RUE DE STRASBOURG
VINCENNES (SEINE) FRANCE

PUBL. RAPY

MEMBER FEDERATION NATIONALE DES SYNDICATS DES
INDUSTRIES RADIOELECTRIQUES ET ELECTRONIQUES

High stability **Resistors**

Actual Size

Very low noise level and temperature coefficient 1/4, 1/2, 1 watt and 2-3 watts models.
Available from ± 10 % to ± 0,5 % tolerance.

Noiseless Potentiometers

Available without switch and with multi-pole switch · Every variation curve obtainable.

Ask for free catalog

Name _____

Address _____

City _____

State _____

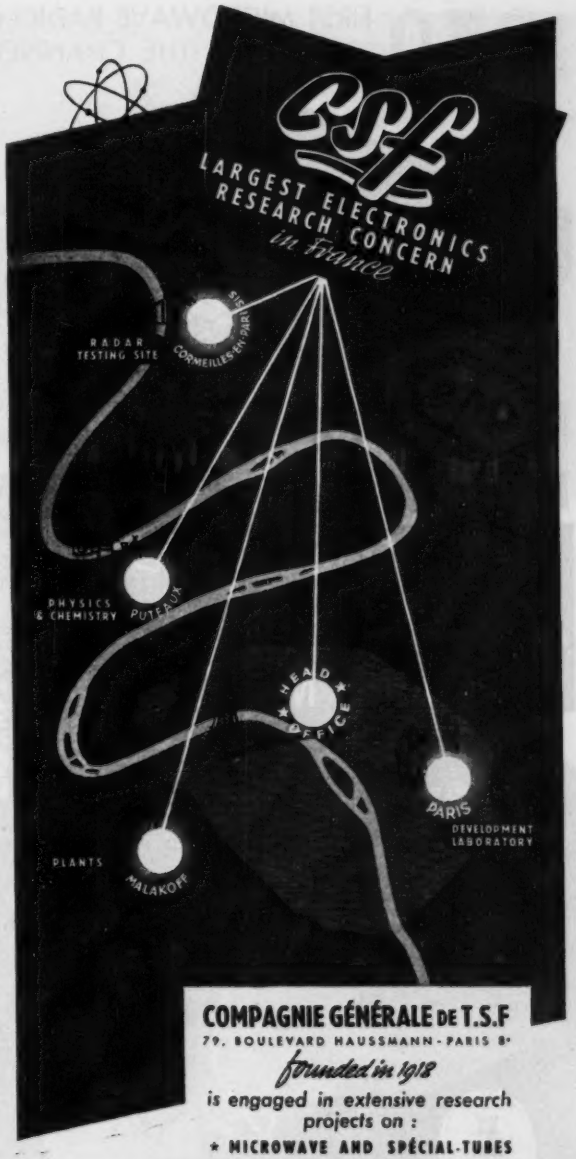
Distributor for U.S.A.:

ARNHOLD CERAMICS INC.
11-54, 44th. Drive
LONG ISLAND CITY-1
N.Y. U.S.A.

GEAD

RADIAC S. A.
206, Rue Lafayette, PARIS-X
(FRANCE)
CABLES SARADIAC-PARIS

MEMBER FEDERATION NATIONALE DES SYNDICATS DES INDUSTRIES RADIOELECTRIQUES ET ELECTRONIQUES



COMPAGNIE GÉNÉRALE DE T.S.F
79, BOULEVARD HAUSSMANN - PARIS 8e

founded in 1918

is engaged in extensive research projects on :

- ★ MICROWAVE AND SPÉCIAL-TUBES
- ★ RADIO-NAVIGATION AND RADAR
- ★ TELECOMMUNICATIONS EQUIPMENT
- ★ BROADCASTING AUDIO AND VIDEO
- ★ RADIO COMPONENTS
- ★ POWDER METALLURGY, & C...

and manufacturing.

PUBLIPHOT

CSF
A MEMBER OF THE FEDERATION S.N.I.R.

Representative for U.S.A.:
AMERICAN RADIO COMPANY
135, BROADWAY • NEW YORK 6

MEMBER FEDERATION NATIONALE DES SYNDICATS DES INDUSTRIES RADIOELECTRIQUES ET ELECTRONIQUES

1930 FIRST MICROWAVE RADIO LINK ACROSS THE CHANNEL

1952

one of the biggest MULTIPLEX RADIO TELEPHONE NETWORKS

L.M.T. *Le Materiel Téléphonique*

Société au Capital de 1 milliard de Francs

46, Quai de Boulogne

BOULOGNE-BILLANCOURT - FRANCE

Ed. GEAD

MEMBER FEDERATION NATIONALE DES SYNDICATS DES INDUSTRIES RADIOELECTRIQUES ET ELECTRONIQUES

DOUBLE BARREL Advertising

Advertising men agree—to do a complete advertising job you need the double effect of both Display Advertising and Direct Mail.

Display Advertising keeps your name before the public and builds prestige.

Direct Mail supplements your Display Advertising. It pin-points your message right to the executive you want to reach—the person who buys or influences the purchases.

More and more companies are constantly increasing their use of Direct Mail because it does a job that no other form of advertising will do.

McGraw-Hill has a special Direct Mail Service that permits the use of McGraw-Hill lists for mailings. Our names give complete coverage in all the industries served by McGraw-Hill publications—gives your message the undivided personal attention of the top-notch executives in the industrial firms. They put you in direct touch with the men who make policy decisions.,

In view of present day difficulties in maintaining your own mailing lists, our efficient personalized service is particularly important in securing the comprehensive market coverage you need and want.

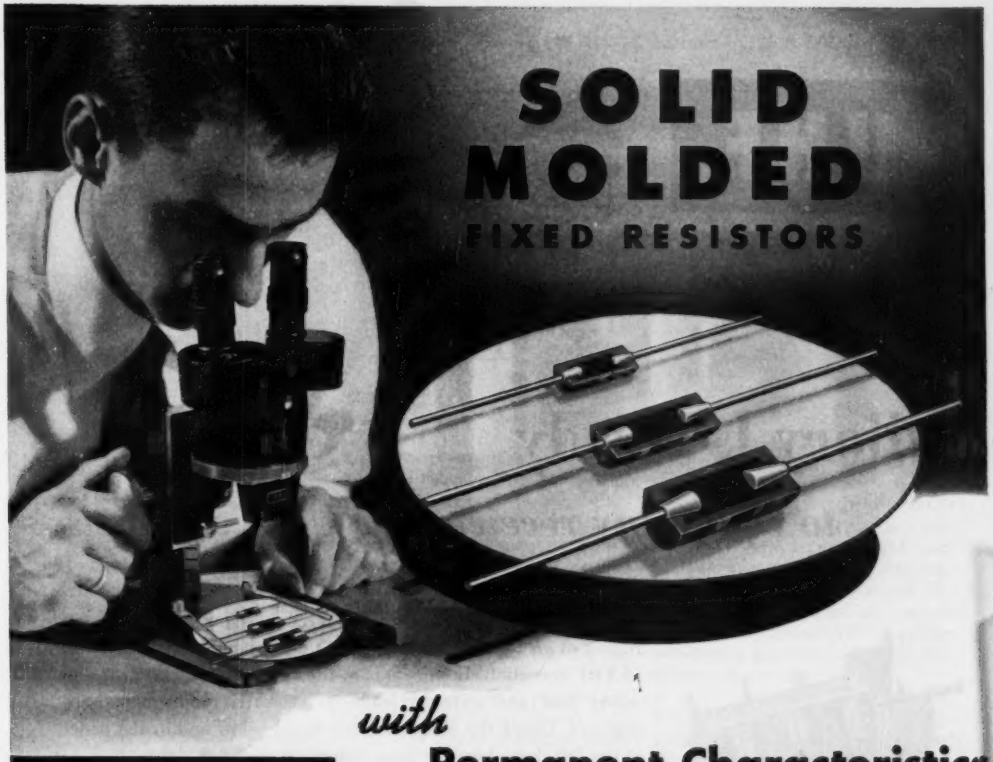
Ask for more detailed information today. You'll be surprised at the low over-all cost and the tested effectiveness of these hand-picked selections.

Dept. A

McGRAW-HILL PUBLISHING CO., INC.

330 West 42nd Street

NEW YORK 18, N. Y.



with

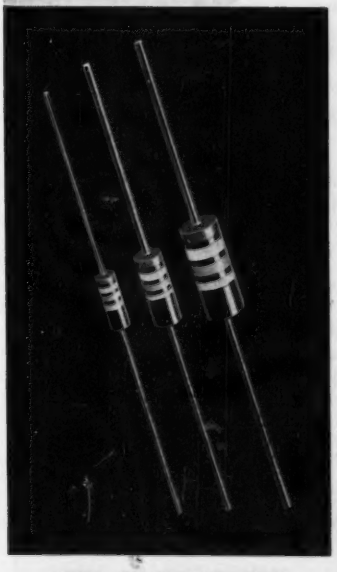
Permanent Characteristics

The solid molded construction gives Bradleyunits a wide safety factor. They are not crowded for performance because they are rated at 70C . . . not at the usual 40C. Under continuous full load for 1000 hours, the resistance change is less than 5 per cent.

They withstand all extremes of temperature, pressure, and humidity. And, don't forget that Bradleyunits require no wax impregnation to pass salt water immersion tests.

Bradleyunits are packed in honeycomb cartons to keep the leads straight and avoid tangling during assembly operations. Made in standard R.T.M.A. values in ½ and 2 watt ratings from 10 ohms and 22 megohms; 1 watt from 2.7 ohms to 22 megohms. Let us send you an A-B resistor chart.

Allen-Bradley Co., 110 W. Greenfield Ave., Milwaukee 4, Wis.



SIZES OF BRADLEYUNITS

Rating	Length	Diameter
½-w	3/8"	9/64"
1-w	9/16"	7/32"
2-w	11/16"	5/16"

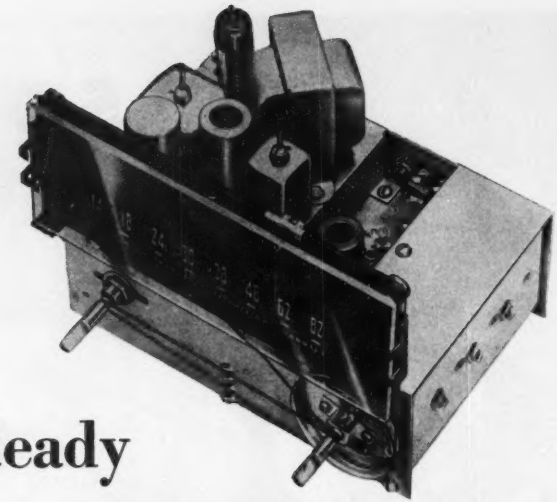
A-B

ALLEN-BRADLEY

FIXED & ADJUSTABLE RADIO RESISTORS

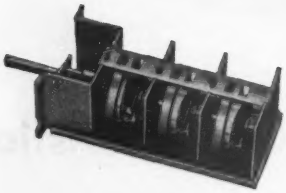
Sold exclusively to manufacturers QUALITY of radio and electronic equipment

UHF



Mallory Is Ready

to equip any receiver for UHF channels



Mallory UHF Tuner

A new version of the continuously variable Mallory Inductuner®, consisting of three sections of variable inductance. Covers the range between 470 and 890 megacycles with approximately 2 micromicrofarads of shunt capacity and in 270° of shaft rotation. Selectivity is excellent over the entire band.

Available now for assembly in your converter or as an auxiliary UHF tuner in your receiver.

Now In Development

A combination VHF-UHF tuner.

The Mallory UHF converter has been designed to permit the tuning of *all* UHF channels by *any* TV receiver, with no sacrifice of VHF reception. Connection to the receiver involves only the power line and antenna leads—no internal adjustments are required. Check the characteristics listed below and in the panel at the left describing the basic tuner.

Physical dimensions 8⅛″ x 6¼″ x 5 3/16″

Built-in IF amplifier operating at the conversion frequency (channels 5 and 6) makes up for conversion and tuning losses

Temperature compensation and stabilization prevents frequency drift after initial warm-up

Low noise figure

High image and IF rejection ratios

The converter chassis is now available to set manufacturers for assembly with cabinets, dial plates and knobs of their design. Complete technical literature will be sent promptly on request.

Television Tuners, Special Switches, Controls and Resistors

P.R.MALLORY & CO. Inc.

MALLORY

SERVING INDUSTRY WITH

Electromechanical Products—Resistors • Switches • TV Tuners • Vibrators

Electrochemical Products—Capacitors • Rectifiers • Mercury Dry Batteries

Metallurgical Products—Contacts • Special Metals • Welding Materials

P. R. MALLORY & CO., INC., INDIANAPOLIS 6, INDIANA

CROSS TALK

►**LONG LINES** . . . Someone, and it might as well be we, should congratulate the Long Lines Department of AT & T on the tv picture quality displayed by the coast-to-coast microwave relay. It's unbelievably good, considering there are 107 relays involved. After 15 years of looking at tv images, we still can't be sure at first glance whether a program is originating here in New York, ten miles away, or in Hollywood 2,900 miles away.

By eye, that is. By ear we can spot the difference, because the accompanying sound has the flat dull tone, long familiar on the radio nets. It's a long circuit, and it's limited to 5,000 cycles, and it sounds like it.

So we have a puzzle: excellent picture and mediocre sound. It gives us to think that the 4,000-kc circuit required for the picture is better engineered than the 5-kc circuit for the sound, despite the fact that the audio engineers had a 25-year head start on the video boys.

As usual such puzzles turn up with economic backgrounds. The alleged justifications of poor sound quality involve the higher cost of better sound circuits. According to the published tariffs on such matters, the 5-kc audio circuit can be had for a monthly cost of $6 per mile and $75 per station connected. If you want a 15-kc circuit and can get the facilities (Continental has one between Washington and New York) it costs $10 per mile and $150 per station, just about double for a multi-station hookup. This 100-percent increase explains why *radio* networks are not flirting with 15-kc lines.

But the economic justification for poor sound quality is vastly less cogent in a *tv* network. The comparable figures (16 hours uninterrupted service daily for a month) for a picture circuit are $51 per mile and $540 per station. With 5-kc sound service this totals $57 per mile and $615 per station. If you want 15-kc sound you have to pay only about 10 percent more (7 percent on the mileage and 12 percent on the station connections). Maybe radio networks, on a falling market, can't afford good sound at 100 percent extra. But tv networks, on a steeply rising market, can certainly afford it at 10 percent extra. We have first-class video circuits, coast-to-coast. Why in tunket can't we give the bird another seed and get first-class audio circuits into the bargain?

►**DELAY** . . . Our investigation into tv networks, incidentally, reveals that the coast-to-coast audio circuits are all carried at radio frequencies, either by microwave or coaxial cable, to keep the sound synchronized with the picture. If conventional wire circuits were used on any distance comparable to the width of the continent, the sound would lag behind the picture by a tenth of a second or more. All of which reminds us that there is a law relating the delay in a circuit and the frequency of operation, which says that short delays come with high frequencies. And another law (less strictly enforced) says that bandwidth comes cheaper on higher-frequency circuits. Which leads to the suspicion that it wouldn't cost too much to widen the tv-sound circuits from 5 to 15 kc, so long as you have to contend with the delay problem in any event. Murray Hill papers please copy, if true.

►**TOP SECRET** . . . In a recent issue of *Newsweek*, General Carl Spaatz wrote a piece "Electronics: The Next Winner" in which he quite properly assessed the importance of electronics in winning a future war. But he went on to say, "Electronic inventions and improvements should be top secret. Some device that improves television reception in your home may be just the thing, when applied to fighting machines, that would give us a decisive edge."

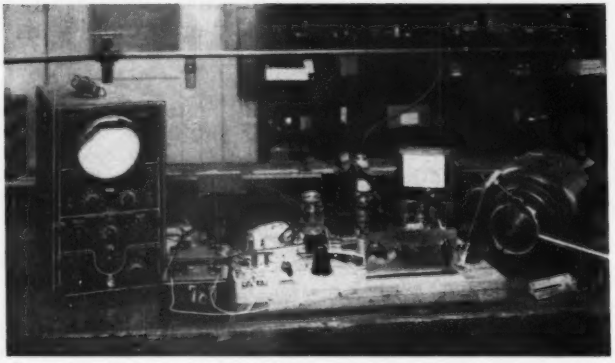
We can be expected to argue with that one, and we do. It's completely unrealistic to suppose that an improvement in television receivers can be kept from the enemy. It can't be unless it's suppressed, not used, and the word kept from our own technicians, beyond the few hundred who can properly have access to secret papers. Even then it's not really secure. The answer is not secrecy, it's continued rapid progress. We do ourselves more good if we pass around purely technical information (keeping operational matters under wraps) just as fast as we can pass it.

How to

By OSCAR E. CARLSON

Vice-President
Servo-Tek Products Co., Inc.
Paterson, New Jersey

1 Conference meeting of management and engineering for initial planning. Initial decisions made here determine broad policy and design objectives



2 Breadboard model and test setup for functional tests. Major component specifications are determined at this point as well as basic circuit design

3 Engineering and drafting for prototype design. Close engineering supervision of all the necessary drafting assures attainment of the proper end result

ENGINEERING DESIGN requires a knowledge not only of basic electric, electronic and mechanical fundamentals, but a thorough understanding of the end requirements as to the equipment's operating conditions and environment. This presupposes a knowledge of the functional equipment requirement.

Normally, the electronic designer is aided in equipment layout and mechanical detail by a mechanical engineer or design draftsman with considerable mechanical design ability. A knowledge of metals, shop practices, production methods and product end use are all a part of the co-ordinated requirements for a complete design problem. A thorough and successful electronic designer must have a minimum basic knowledge of all these fields in addition to his required electronic ability.

A further prerequisite that may be inserted here rather parenthetically, but not of minimum importance, is an understanding of the economics involved, not only for design, but for the entire path of flow, from product conception through design, drafting, production and final marketing of the product. In short, a properly background-educated design engineer becomes by these requirements capable of simultaneously bridging functions which, in many organizations, require a regular family tree of design and executive personnel. The closer a design engineer comes to these requirements, the more valuable he is to an employer, big or small.

→ Initial

Develop a New Product

Practical step-by-step procedure for putting a new electronic product on the market successfully is carried through product conception, design, drafting, production and final marketing. Desirable qualifications for development engineers are emphasized

It is one of the inconsistencies of modern mass-production factories that on one hand broad individual ability is needed, and on the other hand personnel are often trained by such methods that each man has a specific mechanized function. By this type of engineering training employers lose much of the inherent ability that exists in their engineering personnel.

One cannot say that colleges and engineering schools must deliver graduate engineers meeting all the prerequisites. But, the in-plant training and job assignments for student and junior engineers should not be limited to the engineering department nor to straight design functions. Student and junior engineers should become familiar with production methods, tests, purchasing, raw-material specifications, field problems, shop burdens, management burdens and product merchandising. In short, they should learn considerable about the business of which they form a part. It is only when a thorough knowledge of all these has been integrated into their relationship with a product of the company that the company officials may choose the proper paths of administrative action.

The Motive

The primary object of design is profit. This is rather a cold statement. But few companies are in business just for the fun of it. The first questions concerning a contemplated design are then, naturally: "Is there a market for the item? Do similar items sold by competitors have an apparent corner on the market? Will our version do a better job at less expense? Is our merchandising ability such that we can get a share of the available business sufficient unto the size of our organization and the capital risk involved in initiating such design, production and marketing?"

The latter question is extremely important. Few products or designs are exclusive to the functional operation of such an item and, therefore, few electronic designs are new and revolutionary. In short, there is always competition.

Has competition kept pace with the state of the art? The answer is often no. Once a product has been designed and tooled up it becomes difficult in the extreme to make radical modification without large expense for retooling. Henry Ford stuck to the Model T for many many years. But refusal to keep pace with the art was extremely costly. How long may a design be expected to remain modern? Tooling and design costs must be completely amortized before anticipated obsolescence of the design.

The sea of industry is a stormy one. Even the well-established manufacturers with tremendous capital investment and reserve are not immune from the effects of progress. The railroads put the canals out of business. The railroads have suffered severely from motor trucks and aviation, and are now little farther advanced than they were in 1910. It becomes the function of engineering and management to maintain a flexibility for adaptation to rapidly changing state-of-the-art conditions so that business is not lost to a younger and more energetic competitor cognizant of new conditions in the field.

The Concept

Let us first assume that the proposed article is to be made by an established design and manufacturing firm. The problems of design, manufacturing and sales as related to the design engineer and his employer for a new firm are so contingent upon the firm's financial ability to weather the design, tooling and merchandising storm, that those problems are transients rather than more stable, nearly steady-state conditions of a going concern. It must be remembered at this point that it is nearly always a prerequisite that a product of new design have a nonprofit growth period. This usually holds equally true for a new design and manufacturing firm.

The sales manager or various sales representatives for an established firm may request the factory to expand the line of manufactured items. The management group is informed that there is a large market potential, as an example, for electronic variable-speed motor-control systems. This large potential is a relative thing that might not be attractive enough for an extremely large firm.

Upon such a request management is faced with the analytical task of determining answers to the profit-motive questions. It is at this point that the engineering staff is first called upon. First, the existing items on the market must be ex-

Design Planning of a Product Leads To . . . . ⟶

amined from the designer's viewpoint. This examination may in many instances be made only on specifications and published data, without physical examination of actual equipment. The latter is, of course, to be preferred.

Many months of research and laboratory work may be needed to determine if a unit can be produced better than or equal to that of present competition at equal or less price than the competitors'. Can our company improve the design by simplification? What is the patent situation? Are the patent holders manufacturing such items? Can licensing be arranged if needed? Are there any improvements in mind that are of patentable calibre? Are most of the required components available as stock items from other manufacturers, or will the tooling costs be high to make such components?

If tooling costs are likely to be high, will such an expenditure tend to prevent additional competition? It is to be emphasized at this point that being tooled for a production is oftentimes more valuable to a manufacturer than a large number of easily infringed-upon patents.

After managerial assessment of answers to these and other questions, aided by the engineering department, the engineering department may be given the OK to proceed with a preproduction design and functional models. Tentative design specifications are agreed upon between sales and engineering, weighing carefully the claims and merits of the competitors' items. Don't depend on their advertising—analyze their stipulated operational specifications. Fantastic claims can be made for even the poorest design. Here engineering may reduce costs by weighing requirements of sales for gadgets and gimmicks. But remember, the sales manager may know more about the required end results needed than does the equipment design engineer. Therefore, the liaison between sales and design must be cognizant of the abilities and responsibilities of each.

The circuit design must be basically completed in laboratory mock-up units. Radical design changes at a later date during production can be extremely costly. The basic circuit design and qualification testing of same constitutes the culmination of product conception. But the product has a long way to go before that conception gives birth to a recognizable end product.

The Development

Some of the preliminary laboratory design and mock-up work for the typical example of a motor control is, of course, done with non-optimum components. The electronics engineer faced with such a design is brought to the rude awakening that all his electronic specialization has left him lacking in the knowledge of other units associated to his design. The electric motor theory required for such a design necessitates that he do a little homework, brushing-up and plain research in that field. It is soon established that one of the engineering team must be assigned to the problem of becoming a motor expert.

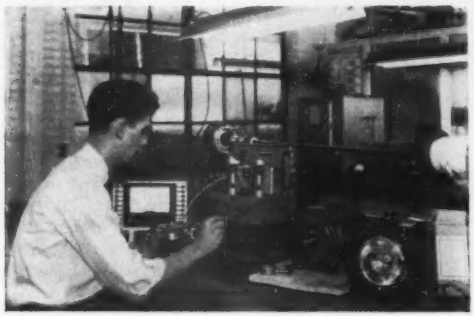
Let us take as a further example the design of a half-wave thyratron-type bidirectional motor control for a d-c motor. For simplicity, the unrectified d-c voltage is desired to be 220 volts. What requirements does this impose on the motor armature? One may assume the motor to be a coupling device between the rectifier tube and the mechanical load, so that it simply converts electrical to mechanical energy.

It will be necessary, therefore, to have a motor armature of such design as to develop at desired base speed a generated emf far below the value for the peak voltage of the applied rectifier sine-wave plate potential. An arbitrary initial design point of logical selection is to allow a long conduction period over the halfwave period. If the first mock-up work is done on a standard 220-volt-armature d-c motor, the results must be prorated on the above basis.

It is known that the motor torque in this instance is proportional to the d-c armature current. But what of the rms value? Evidently the motor must be derated due to this extra heating. How much?

The electronic designer on this assignment must provide tentative motor specifications to the motor

→ . . . . Final Testing, Production, Marketing and



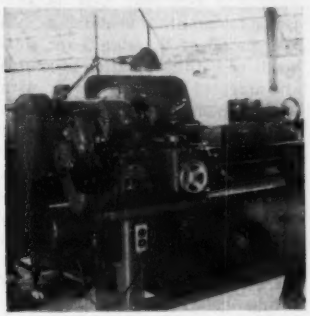
4 Final prototype unit test by engineering. Engineering tests on this unit finalize design for pilot production

5 Electronic assembly and testing. Careful assembly and testing in clean pleasant rooms assure well-constructed products

supplier. Considerable help may, of course, be obtained from the engineering staff of such a motor manufacturer.

While the prototype transformers and motor are being processed, the design engineering group may give thought to final cabinetry or housing. How much heat is to be dissipated in the unit? Will this require forced air cooling? How is the equipment to be mounted? What are the environmental conditions that might affect the housing and cooling requirements? Are

Application



6 Product application. One of the Servospeed units is shown installed on a lathe

service shutdowns permissible? Remember this is no a-c/d-c radio that may lay around the service shop for a couple of weeks. It may have to be restored to operation within minutes of a failure to prevent costly down time on an industrial machine. Servicing must be done by relatively inexperienced personnel. Can plug-in components be used for all critical components such as capacitors, resistors and the smaller sizes of coils and transformers?

For the prototypes or preproduction units the designer should provide sketches to drafting for chassis and enclosure. He should then check these drawings by himself, using model-shop facilities to construct such units. This checks drawings and design for ease of manufacture and results in many small final improvements. If the designer is not set up to perform such model-shop procedure in a particular plant, he should check closely the model-shop procedure and obtain design criticism comments from the model shop. The time and place to iron out manufacturing difficulties is prior to production. This is, of course, not completely capable of achievement, but many wrinkles that crop up in production are the faults of designers!

With circuitry and preproduction models completed, the testing, specification writing and material procurement may be initiated. Upon receipt of preproduction component samples from vendors, further tests must be made to OK such component suppliers to proceed with their production.

The sales group again enters the picture to obtain engineering help in preparing sales literature, new-product releases and advertising data. Comprehensive instruction books and service manuals can be prepared during this interim of procurement. Much of this data is available only from the design group and close liaison is needed. It is of considerable help at this point if the designers have visited and inspected potential installation points and become familiar with actual operational applications of the product.

The End Point

With advertising in the publication mill and the sales group obtaining the first few hard-won sales, the first pilot production run may be launched. The quantity of this first production may be best arrived at by careful analysis of anticipated requirements and delivery schedules that it is desired to meet. Let us emphasize at this point that deliveries should be made from stock on any item for which, as a catalogue or standard item, a company has released data. Nothing is more disillusioning than to get an answer to an inquiry informing a potential customer that deliveries of a newly announced product can be made in several months. In that case the item was not ready for release.

It is regrettable that, at this particular time, items of current manufacture are on long delivery due to defense priorities. That is not, however, an excuse for using new-product releases for market analysis as is consistently done by many manufacturers in the electronic field, including some of the largest and otherwise most reputable.

With the pilot production run there will occur many new problems that require the design engineers' attention — manufacturing procedures, tolerances, minor changes to aid manufacture and tolerances that add up so as to impair performance. All of these may be expected and must be promptly corrected or compensated for in the pilot run to insure a potentially smooth production flow for subsequent production.

The engineering responsibility for the product continues through the plant and for the successful operation of the product in the field. Field failures and complaints may well require design changes of some magnitude to be inserted into subsequent production runs. The drawing and plant record system for such changes must always be kept up to date by engineering so that the shop builds what the drawings call for. There is no excuse for products being constructed contrary to drawings and specifications because of paper-work lag on the part of engineering. Nor can unauthorized deviations from drawings or specifications be allowed to exist where such manufacturing deviations were required. Immediate paper-work correction steps must be taken so that an unbroken record chain carries the complete factory story for the product.

If and when the job of a design has been properly completed and production started, it should be possible for a competent but completely new staff to take over such a design and production at any stage and follow through from the complete and accurate records of the original group. There is no known substitute for complete and accurate drawings together with process sheets and test data to cover a complete product operation.

It is only by such a complete and accurate system that engineering can delegate production authority to less skilled technical personnel so that engineering may return to the starting point of this product for another new one.

Simultaneous A-M and F-M

Two full-time channels on a single carrier allow transmission of complicated data for which sampling techniques are inadequate. One is a video channel 5 megacycles wide used for waveforms and other experimental signals from sounding rockets

By W. CULLEN MOORE*

Project Supervisor
Upper Atmosphere Research Laboratory
Boston University
Boston, Mass.

SIMULTANEOUS amplitude and frequency modulation with two independent messages on a single carrier finds an excellent application in upper atmosphere research using sounding rockets where space, weight, and recording or transmission facilities are controlling factors in determining how many experiments can be included in any one flight. This is particularly true for continuous-carrier transmitters used for relaying video-type signals because the associated power supply usually accounts for a large portion of the total weight of the equipment. The potentialities of the system would seem to justify a fuller investigation than has been reported in the literature.[1,2,3]

The Johns Hopkins Applied Science Laboratory system[4] and the M.I.T. Laboratory for Electronics system[5] are examples of the trends in telemetering from rockets in which sampling techniques are used to increase the number of independent items of information being handled. There are, however, a number of experiments being performed in upper atmosphere research yielding outputs that cannot be sampled. Rapidly varying phenomena, unusual waveshapes, and randomly timed impulse-type signals all require continuous transmission and often large bandwidths.

A cursory examination of the equation for the distribution of energy in the carrier and sidebands of a frequency-modulated wave might lead one to believe that it would be impossible to prevent the frequency-modulation signal from appearing in the output of the amplitude-modulation portion of the system, and vice versa. The relative amplitudes of the carrier and sidebands, given by Bessel functions for the frequency-modulation components, vary through a range of values that may include zero as the signal frequency and amplitude are varied. However, amplitude modulation affects the frequency-modulation carrier and sidebands in the same proportion and therefore does not affect the phase of the vector resultant. Frequency modulation results in a single vector resultant current that varies in phase but is constant in amplitude. It is this constant-amplitude resultant that is subjected to amplitude modulation. As long as all of the significant sidebands of both modulation processes are accepted by the receiver with uniform amplitude response, there will be no transfer of information from either channel to the other ahead of the detection circuits. Experimental confirmation of this conclusion is presented in reference 6.

The radio link from rocket to ground used by Boston University operates on a carrier frequency of 183 mc. The output of a frequency-modulated oscillator operating at approximately 10 mc is increased to the output frequency by a combination of heterodyning and frequency multiplication. The amplitude modulation is applied to the carrier in the final stage either by control-grid modulation or by screen-grid modulation, the choice of modulation circuit depending on the bandwidths of the two signals.

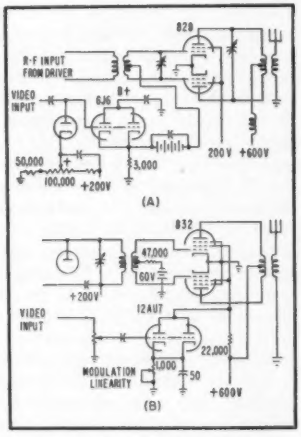


FIG. 1—Wide-band video signals produce a-m (A) by returning grid-bias of final to ground through load resistor of cathode follower. Diode restores d-c level. Screen-grid voltage of final is varied in (B) using tube as ground element of divider circuit

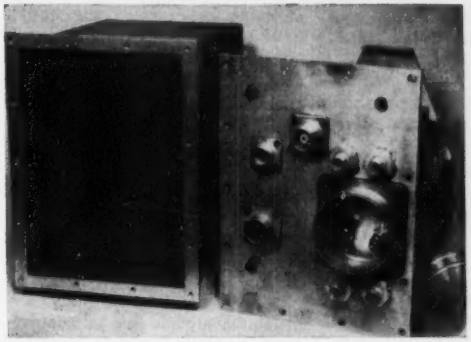
Phase and Frequency Modulators

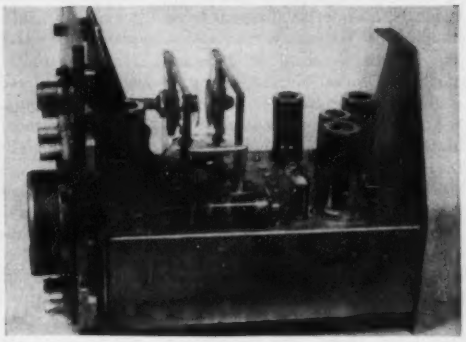
Two types of frequency-modulation systems have been used successfully. One is the practical application of reactance modulation of the so-called overtone crystal oscillator[7]. This circuit has been used on several flights since its adoption in early 1949. The practical experience obtained and the theoretical analysis of the operation of the circuit carried out by this Laboratory confirm the performance characteristics attributed to it in the literature. On recent flights, a more conventional type of react-

The research reported in this paper has been sponsored by the Geophysics Research Division of Air Force Cambridge Research Center under contract AF 10(122)-36.

* Now Chief Engineer, Tracerlab, Inc. Boston, Mass.

in Rocket Telemetering





Rocket-borne transmitter showing massive construction, pressurized housing and pressurized access to adjustments over which cap is screwed

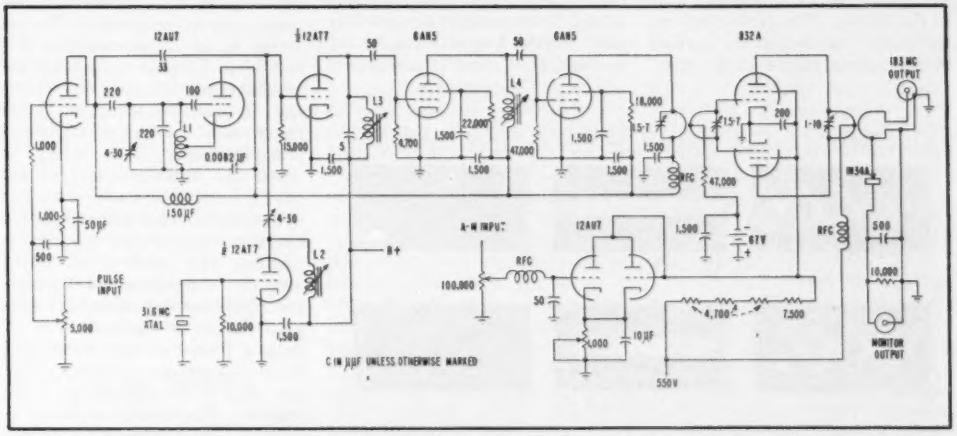


FIG. 2—Rocket-borne transmitter uses reactance modulator for f-m and screen-grid modulation of final stage for a-m

ance controlled oscillator circuit has been used because the transient nature of the pulse signals being handled excited spurious responses in the crystals used. Crystals obtained more recently show improved characteristics in this respect.

The system has been used in two distinct applications. In one case, video signals having components up to five megacycles were applied as amplitude modulation in the grid circuits of the final stage by using the circuit of Fig. 1A. The grids of the output tubes were returned to ground through the cathode-load resistor of a video-frequency cathode-follower stage. A clamp tube in the input of the cathode-follower circuit maintained proper black-level of the carrier.

In the second case, modulating signals having a continuous spectrum up to sixty kilocycles have been applied as amplitude modulation by varying the screen voltage of the final stage at the signal frequency as shown in Fig. 1B. In both cases, the frequency-modulation channel was carrying pulse groups requiring up to thirty kilocycles bandwidth for adequate reproduction. The superaudible signal has also been transmitted as frequency modulation in conjunction with the wideband video signal as amplitude modulation.

Choice of Modulation

In general, it is advisable to apply the modulating signal having the highest frequency components as amplitude modulation because of the requirements placed on the receiver bandwidth. In missile work, however, the signal received over the slant range from the missile to the ground receiving station varies over wide values in a short time and nonisotropic radiation from the antenna on a rolling missile will

cause fades. The best allocation of modulation facilities will depend on which of the signals will more readily tolerate changes in output amplitude, the more critical signal being handled as frequency modulation. The circuit diagram of a recent model of a rocket-borne transmitter is shown in Fig. 2.

For a wide-band amplitude-modulated signal and a narrow-band frequency-modulated signal, separate receivers are satisfactory for recovering each modulation. The amplitude-modulation receiver must have a flat pass band over the full frequency excursion of the sidebands of the frequency-modulated signal. Otherwise, the frequency-modulated signal will recover on the sides of the selectivity curve of the amplitude-modulation receiver and appear as an unwanted signal in the output. The restrictions on the frequency-modulation portion of the system represent the ever-present engineering compromise between how well the frequency-modulation receiver will reject the amplitude modulation and the maximum depth of amplitude modulation required to produce satisfactory results in the amplitude-modulation receiver. In practice, it has been found that sixty-percent peak amplitude modulation represented a good design figure for the applications in which the system has been used, although it has been found possible to operate with up to eighty-five percent peak amplitude modulation.

When the amplitude-modulation signal contains abrupt changes in level, it is sometimes advisable to use types of amplitude limiters in the frequency-modulation receiver that do not depend on the time-constant of a circuit for their limiting action. Time-constant limiters may cause a brief loss of signal to the discriminator circuit immediately following a sudden decrease in signal level because the tube is biased beyond cutoff for the reduced signal. Figure 3 shows a composite modulation on the output wave for the case of plate current limiters as investigated by Schwartz of this Laboratory.[6] The gated beam tube also produces good results in this type of service. However, conventional circuits have been found satisfactory for many types of applications of simultaneous amplitude and frequency-modulated signals.

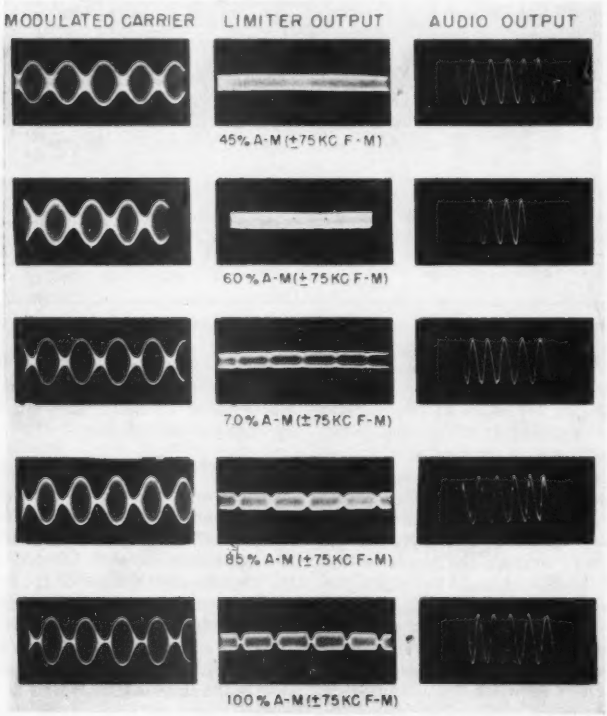


FIG. 3—Effects of varying amounts of amplitude modulation with constant-deviation frequency modulation observed at limiter output and from discriminator

Single Receiver for A-M and F-M

If both amplitude and frequency-modulated signals are of comparable bandwidth, it may be desirable to recover both in the same receiver. This is accomplished by flat-topping the intermediate-frequency signal response of the receiver so as to accommodate the maximum frequency excursions without producing slope recovery of the frequency-modulation sidebands ahead of the amplitude-modulation detector. The extent to which the interchannel crosstalk can be reduced is simply a matter of how much design and adjustment effort the end use of the signals justifies. The circuit of a receiver used for telemetering upper-atmosphere research data from high-altitude rockets is shown in Fig. 4. Both a limiter-current meter and the zero-center discriminator meter are used in the operation of the receiver. The severity of the crosstalk requirements will of course have to be met by equipment designed for each particular application.

To aid in making the final adjustment of percent amplitude modulation while the rocket is assembled in the launcher, a small portable oscilloscope has been modified to provide a base line by intermittently shorting the signal from the diode rectifier in the transmitter output circuit. The normally-open contacts of a relay are connected across the vertical axis input terminals of the oscilloscope and the relay coil is connected through a switch to the filament supply thus shorting the input each time the relay is activated by one half cycle of the alternating current. The

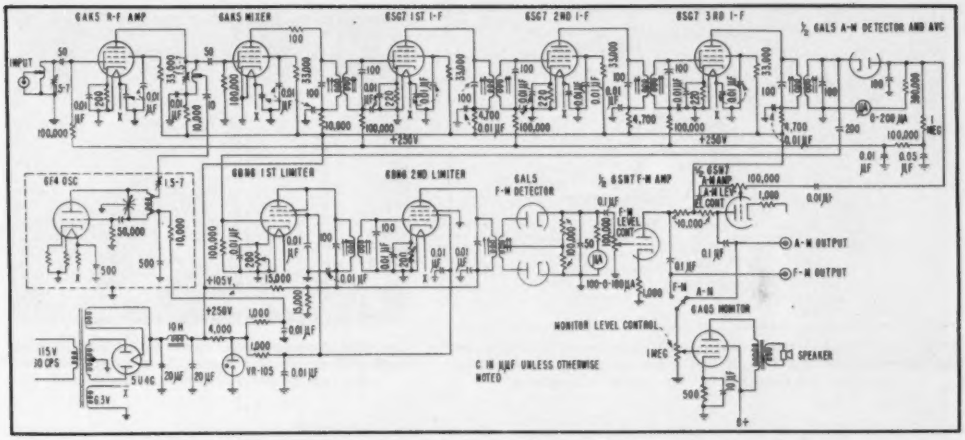


FIG. 4—Single receiver used to recover both a-m and f-m signals from separate detector circuits

result is the establishment of a reference line on the face of the oscilloscope tube which corresponds to the zero carrier level of the amplitude modulated signal being detected by the germanium diode in the transmitter output monitoring circuit. This procedure not only checks the modulation level to prevent loss of quieting in the frequency-modulation receiver, but also provides an overall systems test of the instrumentation feeding the amplitude-modulation circuit in the transmitter.

Pressurized Enclosure

A dual-modulation transmitter designed for use in an Aerobee rocket is illustrated. Since the rocket rises to regions of essentially zero atmospheric pressure, it is necessary to seal off the container at normal ground level atmospheric to prevent arcover of the high voltage at reduced pressures and to provide adequate rigidity to the case to withstand the fifteen-pounds-per-square-inch pressure differential that results when the missile leaves the atmosphere. Special connectors and silicone grease are used to prevent arcover in the high voltage connectors at high altitude. Several of the circuit adjustments, particularly those pertaining to adjustment of modulation levels, must be made with all of the equipment operating in the rocket. Access to these controls is available through the connector body on the front panel as shown. Antenna coupling and tuning are also accessible through front-panel fittings.

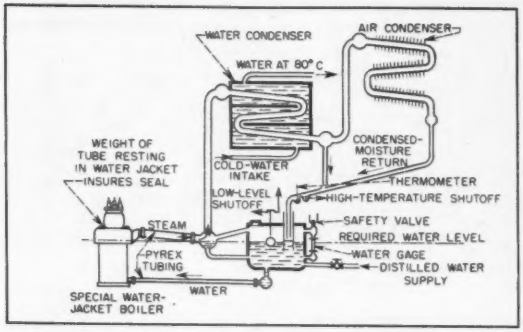
Another requirement placed on equipment intended for operation in rockets is resistance to high-acceleration mechanical shock, not only to prevent permanent damage following the shock, but in many applications to avoid transients being introduced into the data during the application of the shock. Tests for such characteristics are carried out on the drop-table type shock-tester. Details of the drop-table are discussed in reference 8. The transmitter shown here has yielded less than five-percent transient output during 55-g acceleration shocks for both amplitude and frequency modulation as observed on the system receiver and measured on an oscilloscope using the maximum sine-wave modulation as a reference.

In considering the adaptability of a simultaneous amplitude and frequency-modulation system to a given rocket telemetering problem, the power requirements of the transmitter and the size of the case are important factors. The performance of the frequency-modulation system must be predicated on the amount of power radiated at the depths of the amplitude-modulation envelope. A transmitter delivering twelve watts when unmodulated will be effectively only about a three-watt transmitter when amplitude-modulated to a depth of fifty percent. The extent to which the equipment can be reduced in size ultimately comes up against the problem of power dissipation within the sealed case and the maximum allowable temperature rise.[9]

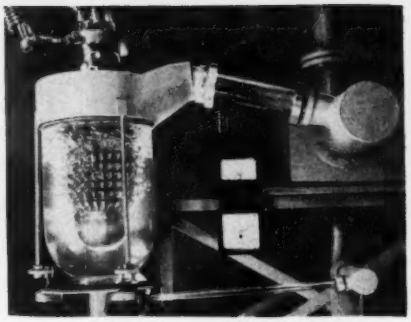
The writer extends his appreciation to the staff of the Upper Atmosphere Research Laboratory of Boston University for their efforts in the development and field operation of this system, and in particular to Mr. Albert Panetta, coinventor of the overtone crystal oscillator circuit[7] and engineer on the transmitter herein described.

References

(1) A. V. Eastman and J. R. Woodyard, Binaural Transmission on a Single Channel, ELECTRONICS, p 34, Feb. 1941.
(2) H. E. Kallman, Audio and Video on a Single Carrier, ELECTRONICS, p 39, May 1941.
(3) P. Caporale, Status of VHF Facilities for Aviation, ELECTRONICS, p 90, Oct. 1947.
(4) G. H. Melton, Multichannel Telemetering for Rockets, ELECTRONICS, p 106, Dec. 1948.
(5) W. R. Cuming, Plastic-Embedded Circuits, ELECTRONICS, p 66, June 1950.
(6) Schwartz and Lissman, Recovery of a Frequency Modulated Signal When a Carrier is Simultaneously Amplitude Modulated *Technical Note Number Six*, Upper Atmosphere Research Laboratory, Boston University.
(7) G. H. Lister, Overtone Crystal Oscillator Design, ELECTRONICS, p 88, Nov. 1950.
(8) Powell, Drop-Table Type Shock-Tester, *Technical Note Number Nine*, Upper Atmosphere Research Laboratory, Boston University.
(9) R. J. Bibbero, Estimating Temperature Rise in Electronic Equipment Cases, *Proc. IRE*, p 504, May 1951.



Evaporation-cooling system depends merely upon maintenance of proper distilled-water level and flow of cold water through water condenser. Ebullition at the special tube plate maintains circulation



Insulation of anode in experimental system depends upon distilled water flowing through long Pyrex tube (bottom) and dry-steam through short tube (above)

Evaporation-Cooled POWER TUBES

Novel anode design and ebullition in water-jacket permit pumpless cooling at three times normal power output of conventionally cooled tubes. System employed for broadcasting and industrial-heating power tubes can also furnish distilled water and building heat

By CHARLES BEURTHERET

Chief Engineer
Broadcast Transmitter Section
Compagnie Francaise Thomson-Houston
Paris, France

RADIO-FREQUENCY amplifiers and industrial high-frequency generators operate at limiting efficiencies of 70 percent, so that about a third of the input energy is dissipated as heat at the anode. At high power, forced-air or circulating water and air are required in removing the heat fast enough to avoid damaging the tubes.

From their inception about 1923, water-cooled vacuum tubes have been used with anode water jackets (usually separate, but sometimes attached to the anode as an integral part of the tube) in which a turbulent flow of water is maintained. The purpose of this turbulence, dependent upon viscosity, density and velocity of the fluid, is to effect a cooling efficiency that is appreciably higher than that in a smooth flow.

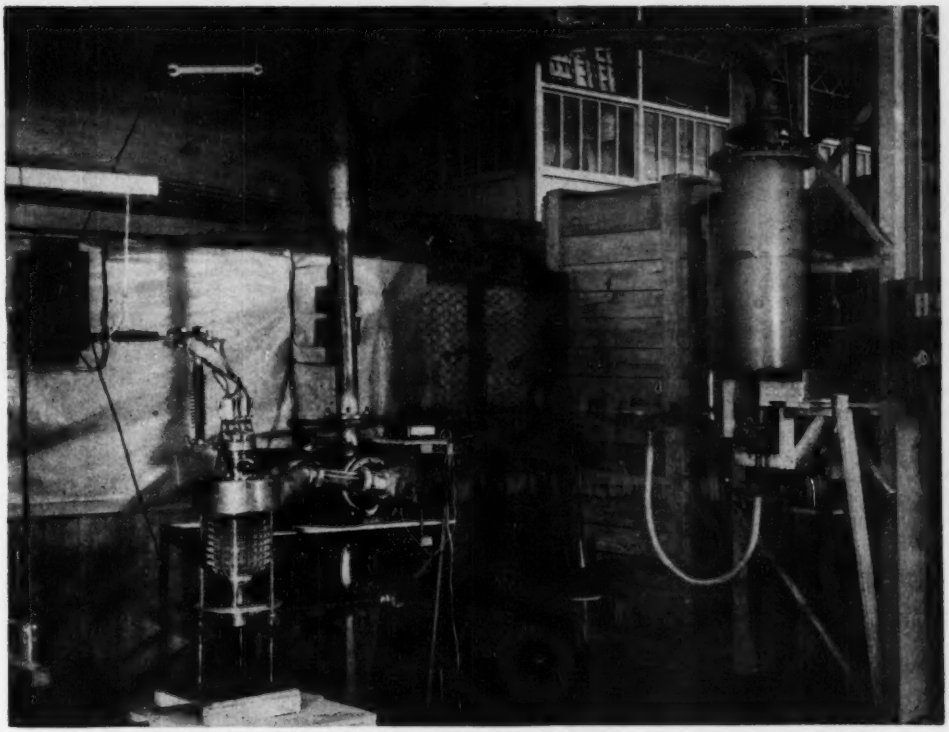
With heat-flux densities as great as those customarily encountered in these services, a water coating in contact with the hot metal may become vaporized. If this happens, an insulating layer of vapor prevents cooling and damage results. It is for this reason that turbulent flow is employed, since it prevents the accumulation of insulated spots.

Calefaction

There are practical limits, however, to the turbulent-flow technique. When an overload is applied to the anode, the boundary layer of vapor, instead of being condensed on the spot by the current of water, forms bubbles that are carried along. The operator is warned of this condition by a characteristic whistling sound. This heated-state phenomenon, known as calefaction, often results in destruction of the tube through perforation of the anode.

The characteristic noise heralding the onset of calefaction may be considered as arising from the violent condensation of steam bubbles in contact with the cold water that carries them along. In the closed water jacket under pressure there is no room for the vapor that occupies a volume a thousand times greater than the corresponding volume of water. This hypothesis is verified by placing such a tube in a pail of water open to the air. Since the bubbles can escape freely, the boiling is silent.

It can further be shown that a tube anode cooled by evaporation is not hotter than the same tube



Complete setup, with tube and water condenser at left and distilled water storage at right. Large copper tube across top acts as air condenser. The equipment served as prototype for an industrial installation as well as a broadcast transmitter

cooled by cold-water circulation. In fact, calculations indicate that the external temperature of the anode may reach values between 155° and 165° C, whereas the boiling point of the water at the pressure in the jacket is between 125° and 135° C. Temperatures in the order of 180° are encountered in air cooling of smaller power tubes.

New Tube

The tube illustrated has a true radiator of special shape that is extremely effective. Thermocouple measurements taken under conditions of evaporation cooling show that operation at 60 kilowatts, corresponding to three times maximum power with conventional water cooling, is accomplished at temperatures of only 120° C.

A salient point in the construction of the experimental evaporation-cooled tube is the use of a massive copper anode having an equivalent thickness between two and three times that for conventional tubes. This construction is necessary since if a point on the anode reaches a temperature more than 25° C above the boiling point of water, the cooling of this point by vapor ceases and can never re-establish itself. This point can therefore be cooled only by conduction through the metal to neighboring points at somewhat lower temperatures. The high conductivity of the copper mass prevents hot spots. Measurements on the new tube fins confirm that under evaporation cooling there is nowhere a temperature differential as great as 25° C above the boiling point of water even with 60-kw power input.

The use of this new cooling technique will allow manufacture of power tubes with output no longer limited by cooling of the anode. Although the internal construction will require redesign, it will be possible to realize more fully the potentialities of filament emission.

One of two experimental units installed on a 50-kw high-frequency furnace at Montreuil, France, has been in operation for over a year working at an average rate of four operations a day, each operation lasting approximately three hours followed by an idle period of one hour. A 100-kw broadcast transmitter on 1,070 kc has been operated successfully 18 hours a day since October 1951 by the French state broadcasting authority. Besides other economies of operation, such a system can supply distilled water and process or heating water in large quantity at a temperature of about 90° C.

F-M Subminiature

By EDWARD KASNER
Project Engineer
Utility Electronics Corp.
East Newark, N. J.

QUANTITY manufacture of the newest version of the Army's f-m transmitter-receiver, the RT-196/PRC-6, is now supplying troops in Korea. The new unit may be used with a number of other new front-line sets, which the older set did not do.

Frequency range for the 13-tube subminiaturized f-m receiver-transmitter is from 47 to 55.4 mc in 43 channels 200-kc apart with a 4.3-mc i-f. Weight of the entire unit, including batteries, is 6½ pounds. Minimum range is one mile over average terrain.

F-M transmitter-receiver in use. When not in use, stainless-steel whip antenna folds conveniently around case of instrument

Circuitry

All stages of the radio set employ single, slug-tuned resonant circuits. Discriminator and i-f slugs are locked in place after tuning. Each r-f slug carries a splined shaft which concentrically engages with a mechanical counter mechanism to indicate numerically the position of its slug. This arrangement permits presetting of the r-f stages when changing from one channel to another.

The schematic diagram of the radio set is shown in Fig. 1. The receiver is a conventional single superheterodyne with a crystal-controlled local oscillator. The transmitter section of the set consists of a Colpitts oscillator, a modulator, a buffer-doubler and a final amplifier.

The modulator is biased 4.5 volts negative by the battery supply. Bias for afc from the discriminator adds algebraically with the battery bias. Audio signals from the microphone are superimposed on the bias voltages.

The plate load of the modulator consists of a germanium crystal diode which is operated at a low current level where its nonlinear current-resistance characteristic is pronounced.

The afc bias and the audio signal control the plate current of the modulator which, in turn, controls the effective resistance of the crystal diode in the plate circuit. The r-f circuit consists of the series combination of this diode and the 6-$\mu\mu$f capacitor, shunting the oscillator tuning capacitor. The effective shunt capacitance across the tuning capacitor varies with the audio signal and the afc bias and, thereby, produces frequency modulation.

Antenna Coil

The 0.67-μh coil in the antenna input circuit serves as a transmitter final tank and as a receiver input coil. The receiver is operative in the transmit position in order to provide sidetone and afc bias. The front end is driven to saturation during transmission but because the resultant loading and detuning reduces the overall gain, no blocking occurs in the i-f stages.

The volume control returns to ground through a fixed resistor to maintain an audible output level at the minimum volume position. The purpose of this is to provide an aural indication of performance regardless of where the volume control is set. When the equipment is turned on, the characteristic f-m background hiss is heard, indicating that the receiver is functioning properly. The presence of sidetone when the PUSH-TO-TALK switch is depressed and the microphone is spoken into, indicates satisfactory transmitter operation.

Alignment Switch

The switch in the filament circuit of the first i-f stage is opened during transmitter alignment. Its purpose is to reduce i-f gain to prevent tuning to a spurious cross-modulation frequency which may be generated within the mixer. When the switch is opened, the predominant

Transmitter-Receiver

New Signal Corps f-m unit, already in use in Korea, has improved performance over previous model. Receiver uses two r-f and three i-f stages with crystal-controlled local oscillator. Transmitter has self-excited oscillator with reactance modulator

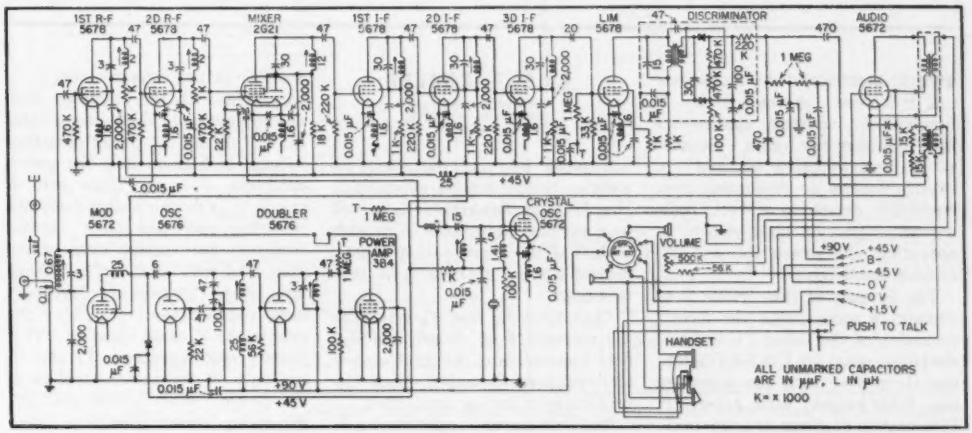


FIG. 1—Schematic diagram of the f-m hand radio transmitter-receiver. Leads marked *T* are convenient test points for maintenance purposes

4.3-mc mixer signal is coupled to the second i-f amplifier through the tube and distributed capacitances in the first i-f stage.

The master switch in the right-hand portion of Fig. 1 connects the plate and filament negative returns to ground in either ON position. The earphone and microphone returns are grounded in the INTERNAL position; the corresponding leads to the external handset connector are grounded in the EXTERNAL position. In the OFF position, all four controlled ground leads are opened.

Discriminator Design

The discriminator presented a severe coil design problem because of the small space available and the resultant difficulty in obtaining high Q and sufficiently loose coupling. The other components within the assembly had to be carefully located in order to maintain Q and minimize undesirable capacitive coupling between primary and secondary.

The discriminator is the source of afc voltage and, therefore, the stability of the transmitter is primarily dependent upon the quality of the discriminator. The tuning slugs are locked after alignment by collet and jamb-nut retainers. The discriminator can and cover are seam-soldered and leads are brought out through metal-to-glass feed-through insulators. A sealing cap and a rubber ring are tightened in place over each slug after alignment to provide a completely sealed discriminator which cannot suffer detuning from ambient climatic changes.

During development, considerable difficulty was encountered with i-f and front-end regeneration. Although specific cures are non-existent, the following precautions are mentioned to assist other designers of subminiature equipments.

Interstage Shielding

Complete interstage shielding should be used. Short and properly located ground returns, adequate and properly located decoupling and bypassing and careful layout of leads and components to minimize intercoupling are recommended. Circuit designs should take into account the broad performance tolerance ranges of subminiaturized components, particularly tubes.

The author gratefully acknowledges the advice and assistance extended by U. S. Signal Corps personnel during the final development and early production phases of the work, particularly to Robert Johnson, Frank Caruso and Frank Kovalski.

New Industrial Motor Control Circuits

Step-by-step analysis of each stage in latest 16-tube electronic motor control system for regulating speed of a d-c motor at any desired value from zero to the top field-reduction speed, as required for maximum flexibility in industrial plant drives

By E. F. KUBLER
Control Department
General Electric Co.
Schenectady, N. Y.

THE ELECTRONIC d-c motor control has proven itself in hundreds of industrial applications over the past few years. Because of an everwidening demand for precise control at reasonable cost, electronic drives have been redesigned to provide improvement in operating characteristics and increased flexibility.

The purpose of this article is to explain in some detail the circuit operation of the latest Thy-mo-trol electronic panel for ¾ to 3-hp motors operating over both the armature and field ranges, with reversing. Five control features are provided:

(1) A speed control circuit regulates the speed at any value from zero to top speed under any load condition. The speed is varied in the armature range by increasing the armature voltage until rated motor voltage is obtained, and in the field range by decreasing the field current until top speed is obtained.

(2) An IR drop compensation circuit increases the armature voltage by an amount proportional to the load current.

(3) A current limit circuit prevents the flow of excessive current during acceleration or under abnormal loads.

(4) An overvoltage circuit prevents the generation of high voltages during deceleration or reversal.

(5) A constant-power accelerating circuit provides the maximum torque during acceleration in the weak-field range.

Armature power for the motor is furnished by thyratrons V_1 and V_2 whose grid voltages are phase-shift-controlled by the inductance-resistance bridge method, as shown in Fig. 1. Saturable reactor L_1 is used as a variable inductance to provide a shift of 180 degrees when the d-c control current changes from zero to 4 ma.

Capacitors C_4 and C_5 minimize the magnitude of undesirable signals induced into the grid circuit and resistors R_4 and R_5 limit the grid current during conduction.

The field power supply, shown in Fig. 2, is similar to the armature power supply. A resistor (R_F) with constant thermal coefficient is used in series with the field to provide a 30-volt drop for control purposes. Where the motor speed range does not require field weakening, a simpler uncontrolled two-phanotron rectifier is used.

Control current for the saturable reactors and plate voltages for all amplifiers are provided by rectifier V_6 in Fig. 1, with V_6 and V_7 providing fixed reference voltages even though currents range from 5 to 40 ma.

Motor Speed Control

Operation of the speed regulator must be considered separately for two distinct conditions, when the motor is operating at full field and below rated armature voltage, and when the motor is operating at rated armature voltage in the weak-field region.

The armature voltage is regulated by the lower portion of the circuit shown in Fig. 1. The filtered rectifier output voltage across C_{11} is compared with the reference voltage by means of resistance divider R_{15}-R_{18}. When the motor armature voltage is higher than the preset reference value of P_1, the grid of triode V_8 is driven positive and the resulting increased plate current increases the voltage drop across plate load resistor R_{16}. The voltage drop across this tube is correspondingly reduced, thereby driving the grid triode V_9 more negative. This phases back thyratrons V_1 and V_2 and cuts off the power supplied to the motor. With power shut off, the motor coasts toward a lower speed until the voltage across C_{11} matches the armature reference voltage, where the thyratrons conduct again in order to maintain the motor speed.

Armature IR Compensation

If the motor voltage had been low, the reverse action would have taken place and the motor would have been accelerated until the proper motor voltage had been reached. The armature thyratrons V_1 and V_2 are thus continuously controlled so the motor voltage matches the reference voltage regardless of motor load.

Because of armature IR drop, motor speed will droop with increasing load. This means that the motor voltage must be increased by an amount equal to the IR drop to maintain the motor speed constant. This is obtained with an IR compensation circuit, shown just above the phase-shifting circuit in Fig. 1. The two primary windings of a special current transformer are corrected in series with armature

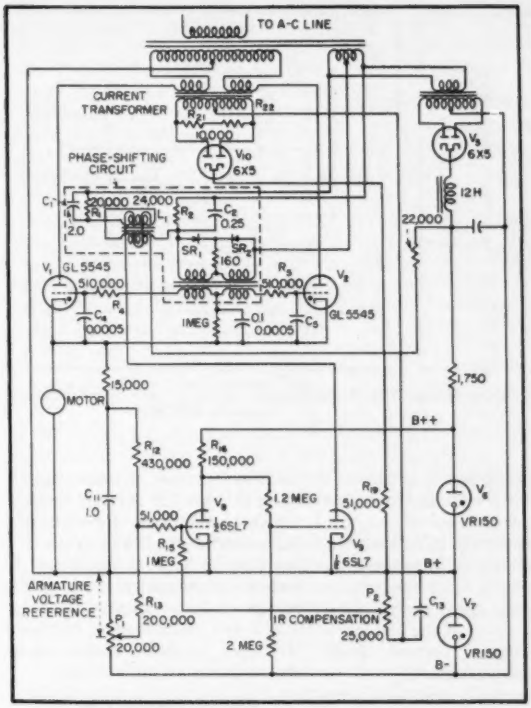


FIG. 1—Basic speed control circuit for furnishing armature power to the d-c motor

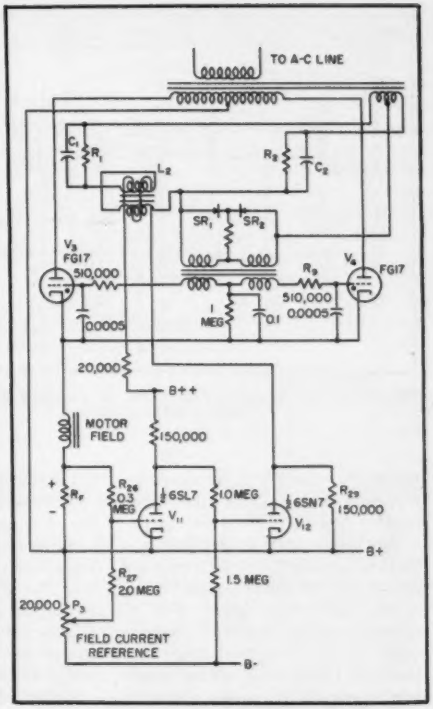


FIG. 2—Field current power supply for field-weakening speed control

thyratrons V_1 and V_2, with polarity such that the resulting magnetic flux due to the current pulses in each winding is equivalent to an a-c flux. The secondary winding is connected to loading resistors R_{21} and R_{22} which determine the transformer output voltage. Tube V_{10} rectifies the secondary a-c voltage and provides across R_{19} and P_2 a d-c voltage proportional to the armature current. The IR compensation control P_2 applies a preset portion of this voltage to the grid of V_6 through R_{15}, so that a signal voltage proportional to motor current is added to the speed reference signal, producing an increase in armature voltage with an increase in load current.

Field Current Control

By adjusting P_2 it is possible to compensate for the IR drop and obtain any desired drooping or rising speed-load curve. Since the IR compensation operates on the armature voltage, it is independent of the field current and covers the entire speed range.

Field weakening is obtained with the control circuit of Fig. 2, in which the motor field is connected in series with resistor R_F. The positive voltage drop across R_F, proportional to the field current, is compared by means of resistance divider R_{26}-R_{27} with the adjustable negative reference voltage set by potentiometer P_3. Any difference voltage acts through triodes V_{11} and V_{12}, saturable reactor L_2 and the phase-shifting circuit to phase the thyratrons V_3 and V_4 further on or further off to correct the field current value and restore the voltage match, just as for the armature control of Fig. 1.

Resistor R_{29} is connected across V_{12} to avoid zero current in the saturable reactor, thereby preventing a complete shutoff of the motor field.

Armature and field reference potentiometers P_1 and P_3 are driven from a common shaft, and their resistance elements are arranged so that during the first part of a clockwise rotation an ever-increasing armature voltage reference is called for by P_1, with P_3 calling for a constant field current until rated armature voltage is reached. For the second part of the rotation P_1 calls for constant motor voltage and P_3 calls for an ever-decreasing field current until weak field is reached.

The angle of potentiometer rotation where the control reference changes from armature control to field control depends on the motor rating. For instance, a motor having a top speed equal to twice base speed would have a control device with the changeover point at one-half the total rotation, whereas a motor having a top speed of three times base speed would have the changeover point at one third of the total rotation.

The resistance element of P_3 is

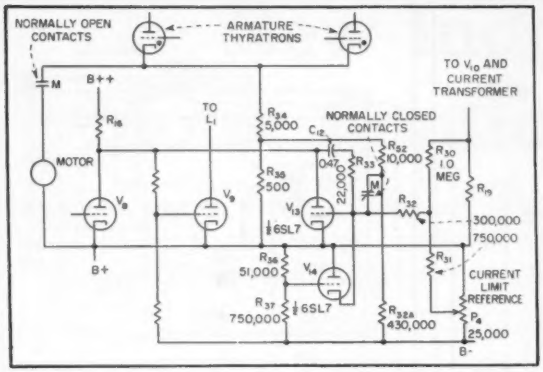


FIG. 3—Armature current-limiting circuit for protecting thyratrons during starting or heavy loading

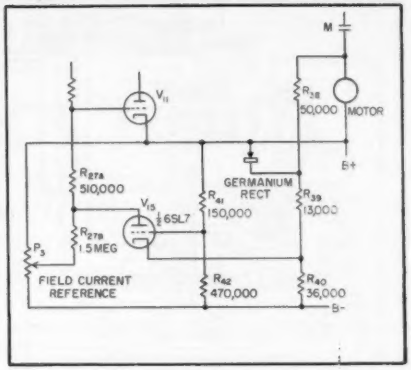


FIG. 4—Field-forcing circuit for maintaining maximum torque in field range

tapered to provide linear speed increments for equal angular increments of the potentiometer shaft.

The motor must be designed and built to operate in the field range if acceptable IR compensation is expected above base speed. For instance, a motor designed to operate solely in the armature range may have an undesirable rising speed-load characteristic when operating in the field range although the armature compensation is adjusted for flat compounding in the armature range. The reason for this undesirable performance can be found in the armature cross-magnetizing field. The cross flux distorts the main field flux and reduces the motor emf for a given speed, consequently the motor speed increases with load when operating in the weak field range. For satisfactory speed performance in the weak field range, the motor must be provided with a bigger air gap and a heavier field pole structure.

Current Limit Control

To prevent damaging current from flowing through the armature rectifier tube under starting conditions or heavy loading, the current-limiting circuit of Fig. 3 has been added to the speed-regulating circuit. For efficient operation this circuit must not interfere with the motor speed when it is operating at normal load. This means that the current limit circuit must have a sharp take-over characteristic when the motor current exceeds a preset value that is selected in advance.

Voltage divider R_{30}-R_{31} compares the voltage drop across R_{19} in the current transformer circuit with a reference voltage set by potentiometer P_4. Current limit tube V_{12} is in parallel with speed control tube V_{10}, hence V_{12} shuts off the armature thyratrons under current limit action when it overrides V_{10}.

Under starting conditions the current is regulated at a preset value until the counter emf is sufficiently high to limit the current to a smaller level. With normal motor load the grid of V_{12} is held sufficiently negative to keep this tube below cutoff, and speed regulator tube V_8 is in full control. Circuit components R_{35} and C_{12} filter the grid voltage of V_{12} and stabilize the operation of the current limit circuit.

Since the motor voltage is measured on the rectifier side of normally-closed contactor M, the speed-regulating circuit will hold the rectifier voltage at the value called for by speed reference potentiometer P_1 when the motor is disconnected from the rectifier. If the motor were started with P_1 set above base speed, the full rectifier voltage would be applied to the motor at the moment the contactor closes. Unfortunately the current limit circuit cannot operate instantaneously because the grid of V_{12} is held negative by P_4 when contactor M is open and C_{12} will prevent the grid of V_{12} from reaching the operating range instantly. This condition cannot be tolerated because currents of destructive magnitude would flow for the first instant after the motor is started, resulting in blown anode fuses. To remedy this condition the rectifier voltage is automatically regulated to a lower voltage when contactor M is open, by means of the preconditioning circuit.

Preconditioning Circuit

This circuit regulates the open-circuit rectifier voltage to a permissible value and provides good starting torque without harmful effects.

A part of the armature rectifier voltage, obtained from R_{34} and R_{35} (Fig. 3), is fed back to the grid of V_{13} through R_{38} and a normally-closed interlock of the main contactor M. When contactor M is de-energized the voltage across R_{35} is compared with the reference voltage provided by glow tube V_7 (Fig. 1) by means of resistance divider R_{27} and $R_{39}A$. These resistors are chosen so that a precondition voltage of 20 to 70 volts is obtained, depending on the horsepower rating of the motor. This particular resistance network is stiff enough to prevent any interference from the current limit reference.

A similar situation may occur when the speed is suddenly increased. If the motor is operating at light load, the grid of V_{13} is held very negative by virtue of current limit reference P_3, consequently C_{12} has a negative charge. If the speed

potentiometer is suddenly turned to a higher speed a large instantaneous current flows because C_{12} prevents the grid of V_{12} from reaching the operating range immediately. Tube V_{14} prevents the grid of V_{12} from drifting too far below its operating range. The grid of V_{14} is held approximately 10 volts below its plate by R_{39} and R_{37}. Since the cathode of V_{14} cannot exceed this voltage, the grid of V_{12} is also held approximately 10 volts negative; this 10-volt negative bias prevents V_{12} from interfering with the normal operation of V_{6}.

Acceleration With Preset Top Speed

With the circuits previously described, it is possible to start and accelerate the motor to any preset speed without the risk of overloading any part of the equipment. However, if the speed control calls for a speed in the weak-field range, the motor will accelerate to top speed with a small accelerating torque depending on the field current value.

This condition is corrected by the field-forcing circuit of Fig. 4, which maintains full field through the armature range and maintains maximum torque in the field range.

When the motor armature voltage is less than 90 percent of rated value the cathode of V_{15} is held at 40 volts below B+ by the germanium rectifier and voltage divider R_{39}-R_{40}. Voltage divider R_{41}-R_{42} is adjusted to hold the grid of V_{15} 38 volts below B+ so that V_{15} is turned on as long as the motor voltage is less than 90 percent of rated values. With V_{15} turned on, the voltage drop across R_{39} provides a new reference for the field current regulator, forcing the field current to full field. When the motor voltage reaches 90 percent of rated value, V_{15} is slowly turned off and the reference is automatically transferred to P_{3}. With this circuit the armature voltage will be maintained at 90 percent of rated value during acceleration in the weak field range until the desired field current is reached. At that moment the armature voltage increases to the rated value, forcing the potential of the cathode of V_{15} above its grid potential and thereby preventing any further interference between the field reinforcing circuit and the normal field current regulating circuit.

Armature Forward Voltage Limit

When the speed control is suddenly turned from a high-speed weak field to a low-speed full field setting, the armature voltage may rise to a dangerous value as the motor coasts to the lower speed while full field is called for by the field current regulator. This voltage rise is prevented by an additional voltage-sensitive circuit in the field current regulator which reduces the field current when the armature voltage rises above a preset value. Figure 5 shows the components added to the field current regulator.

Under normal running conditions the voltage across R_{44} is much lower than the voltage across R_{45}, consequently V_{16} is biased off and has no influence on the field current regulator.

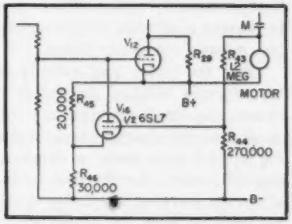


FIG. 5—Armature forward voltage limit circuit

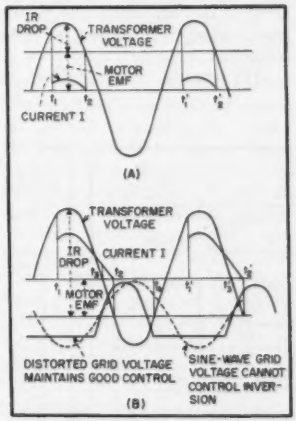


FIG. 6—Simplified curves showing reversing action, with effects of tube drop and armature inductance neglected

When the motor voltage rises beyond a safe value, the grid potential of V_{16} rises and this tube conducts, pulling down the grid potential of V_{12} and thereby phasing off the field thyratrons to reduce the generated motor voltage. During deceleration, the motor voltage is regulated at a preset value determined by R_{40}, R_{41}, R_{42} and R_{43}.

When the motor reaches the lower speed called for by the speed control, V_{16} returns to its normal biased condition with no further effects on the field current regulator.

Reversing of Motor

For simplicity the diagrams shown so far are for a nonreversing motor control. For reversing service, the d-c motor is reversed by changing the polarity of the armature with contactors. Since the overvoltage and field-forcing circuits are connected to the positive terminal of the motor, a simple arrangement of resistors and selenium rectifiers is used to maintain positive polarity for these circuits regardless of direction of rotation.

Dynamic Braking

For efficient dynamic braking it is advisable to maintain the motor voltage near the rated value as long as possible during the deceleration in the field range. This is done by the field-forcing circuit, which also controls the acceleration as previously mentioned.

Under dynamic braking action the armature voltage tends to fall and the field current rises as V_{15} is turned on. This tube will hold the armature voltage at a value determined by R_{39}, R_{38} and R_{40} in Fig. 4.

Under normal conditions when the motor pulls a mechanical load, the armature emf opposes the rectifier output and the motor IR drop is represented by the difference between rectifier output voltages and the emf, as shown in Fig. 6A.

Current I starts at t_1 where the thyratron fires, and stops at t_2 where the emf becomes larger than the transformer voltage. At that moment the emf tends to reverse the direction of current flow, but since the thyratron cannot conduct in the reverse direction, the current through the motor stops. However,

if the motor is suddenly reversed, then while the motor still rotates in the original direction, the emf adds to the transformer voltage and the IR drop is equal to the sum of the emf and transformer voltage. As Fig. 6B shows, from t_1 to t_2 the current flows in the same direction as the transformer voltage, and consequently power is supplied from the power system to the motor. However, from t_2 to t_3 under the influence of the emf the current flows against the transformer voltage and the power flow is reversed from the motor into the power system.

If after motor reversal the thyratron grid had been phased back to point t_2, the tube would fire under the influence of the emf alone and all the power would flow from the motor into the power system. It is evident that the greater the emf the more power is returned to the power system. The emf cannot exceed the maximum transformer voltage, otherwise the tube anodes would remain positive and the thyratron control by grid action would be lost.

The foregoing operation, known as inversion, is a convenient and efficient method of reversing the motor because nearly all kinetic energy is returned into the power system as long as the motor rotates in the original direction.

The grid voltage is distorted away from a pure sine wave in the phased-off position by R_1, R_2, C_1, C_2, SR_1 and SR_2 in Fig 1. With a sine-wave grid voltage the tube would be refired at t_4 in Fig. 6B when the grid and anode voltages are both positive with respect to the armature emf, causing loss of control.

For satisfactory inversion operation the thyratron grids must be immediately phased back to a point where the current will not be excessive and the field-forcing circuit must be restrained to prevent the motor emf from exceeding a safe value.

The first condition is obtained by allowing a delay of 0.1 second between the opening of the forward contactor and the closing of the reverse contactor, so that sufficient time is allowed to phase back the thyratron grid by means of the preconditioning circuit shown in Fig. 7, which is similar to Fig. 3 except that a normally closed contact of relay *CR* is used in place of contactor *M*.

Relay *CR* is deenergized when both contactors are open. During the small time delay between the opening of the first contactor and the closing of the second one, the normally closed contact of *CR* will bring the grid of V_{1B} into range and charge capacitor C_{12}. This helps to prevent a current overshoot when the reverse contactor closes.

Since the motor emf adds to the transformer voltage just after reversal, the small amount of phase-on due to the normal preconditioning circuit may cause a damaging slug of current for the first instant after the reverse contactor closes. To prevent this, R_{32} shuts off the armature thyratron by adding an additional positive voltage to the grid of current limit tube V_{1B} when the motor is coasting in either direction.

The reverse motor emf is held at a safe value by adding a circuit to the overvoltage limit circuit of Fig. 5. As shown in Fig. 8, R_{34} and R_{35} are connected differently and R_{34A} and R_{34B} replace R_{34}. As long as the motor emf opposes the rectifier voltage, the junction of R_{34A} and R_{34B} is connected to B+ by SR_2 and V_{1B} will protect the motor. However, the first instant after reversal the cathode of thyratrons V_1 and V_2 are negative because the motor still turns in the original direction. With SR_2 no longer conducting, the cathode of V_{1B} goes more negative. The grid of this tube will remain stationary because of SR_1 or SR_2 in Fig. 7. The change in cathode potential turns on V_{1B} and cuts off V_{1D}, thus preventing an excessive inverse armature voltage.

The current limit circuit determines the magnitude of the current during reversal. It can be adjusted to prevent motor overheating if frequent reversals are required.

Jog at Low Speed

When the control system is adjusted to run at very low speed, the voltage called for by speed reference P_1 may be less than the voltage called for by the preconditioning circuit, a condition which causes sluggish motor starting. In this case the armature resistance prevents a large initial current flow, and the IR compensation circuit builds up the current after a small time delay. This condition is corrected by introducing a false IR signal obtained by precharging the IR compensation filter capacitor C_{13} through a normally closed contact of the *CR* relay and R_{34} in Fig. 7.

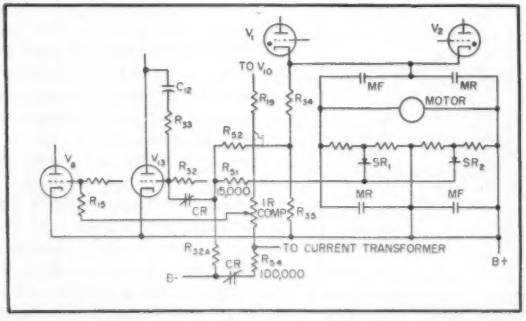


FIG. 7—Preconditioning circuit for phasing back thyratron grids

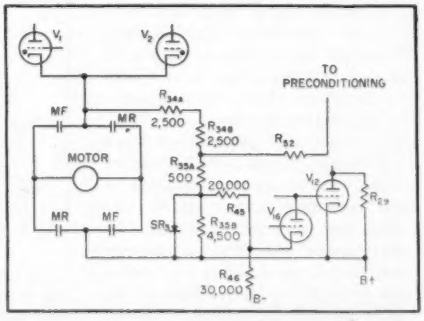


FIG. 8—Inverse voltage limit circuit

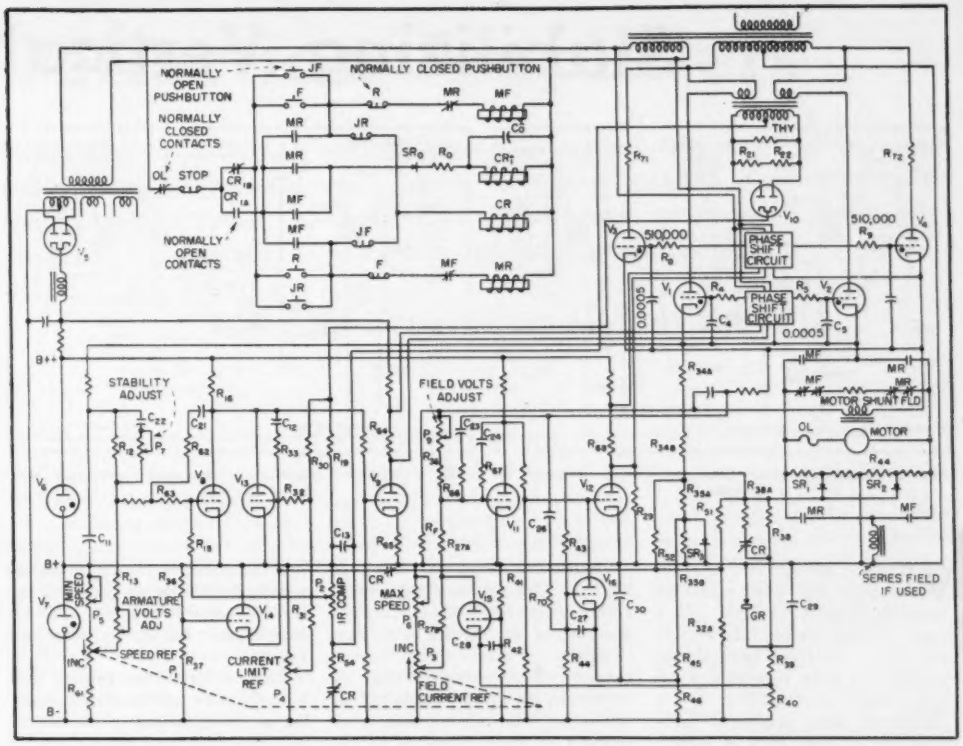


FIG. 9—Complete Thy-mo-trol electronic drive incorporating the individual circuits described in this article

Changing the value of R_{44} changes the initial starting torque over a wide range.

Complete Circuit

The circuits described are redrawn in Fig. 9 as a complete electronic motor control system. In the armature circuit here, P_5 sets the minimum speed. The armature adjustment compensates for poor resistor tolerances and sets armature voltage at full speed.

In the field circuit, P_6 sets the maximum speed and P_9 the maximum field current. Also, P_7 and C_{22} improve the speed of response of the system by transmitting small transient speed changes to the grid of V_{9a}. Combinations R_{60}-C_{21}, R_{61}-C_{20}, R_{57}-C_{24} and R_{77}-C_{26} improve the stability of the armature voltage, the field current and the over-voltage circuit.

The field voltage for field stability circuits R_{66}-C_{23} and R_{70}-C_{25} is filtered by R_{66}-C_{23}; C_{27}, C_{28}, C_{29} and C_{30} are bypass filters preventing the amplification of ripple voltages; R_{41} reduces the maximum reference voltage; R_{42} in the grid circuit of V_{9a} places the IR drop compensation nearer the grid than the stability circuit R_{57}-C_{24} to minimize interference between the stability circuit and the IR compensation signal, giving priority to the latter signal when the motor is subjected to sudden load changes. Also, R_{34} and R_{35} bypass the d-c windings of the saturable reactor to provide a discharge path for the higher harmonic voltages induced into these windings; R_{36} provides a higher speed of response of the saturable reactor control circuit; R_{71} and R_{72} are surge resistors reducing the stiffness of the anode circuit of the field current rectifier so that smaller tubes can be used.

A quick slowdown attachment can be added to pull in a dynamic braking contactor to provide braking action when the motor coasts from a higher to a lower speed.

Another available feature is preset jog speed, which predetermines the speed at which the motor is jogged and allows accurate positioning of the armature.

A field loss relay can be used on those applications where the motor can be mechanically disconnected from the load. Under normal load conditions the motor comes to a stop when the field is lost because the small torque provided by the current limit and residual field is insufficient to overcome the load.

A tachometer follower drive will maintain any speed dictated by another machine. The rectified output of a solenoid control can also be used in the reference circuit, changing the drive from a speed control to a position control as required for reeling drives where a dancer roll operates the solenoid.

Stabilizing Vertical

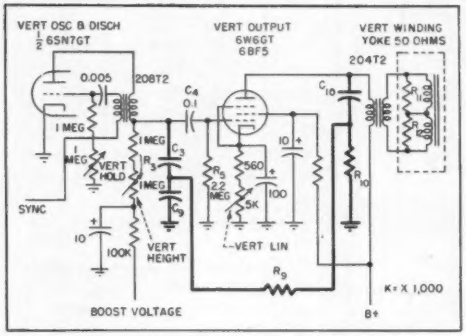


FIG. 1 — Blumlein's circuit employing inverse feedback for stabilization

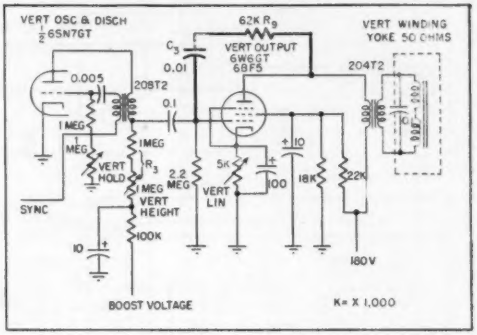


FIG. 2—Simplified circuit gives equivalent performance with fewer parts

VERTICAL DEFLECTION circuits for television have remained almost unchanged for more than a decade, in fact the circuits used in present-day receivers have almost precisely the same resistor and capacitor values as in 1938.

However, some engineers[1] have noted the changes both in height and linearity of the picture in many receivers during warm-up and with changes in the characteristics of the output tubes.

Also, triode output circuits have been used to the exclusion of beam tetrode or pentode due to the prevalence with the latter of objectionable horizontal white lines. These white lines, caused by small perturbations in the plate current of a large percentage of tetrodes and pentodes, are quite unstable, moving from one region to another in the structure of the picture.

While investigating the problems of white lines, linearity and stability of height, it seemed worthwhile to consider the performance of circuits with inverse feedback and also to analyze the factors influencing interlace stability.

Starting with the work done by A. D. Blumlein and described by O. S. Puckle[2] and then applying modifications of this approach, some remarkable improvements in vertical deflection stability have been obtained.

Blumlein's circuit is shown in Fig. 1. The feedback network is shown in heavy lines for clarity—the rest of the circuit being conventional. A detailed experimental analysis of the circuit reveals an important advantage, which is that the output is largely independent of changes in characteristics of the output tube. This makes vertical linearity virtually independent of tube age.

Further experiments and mathematical analysis led to the simplified circuit of Fig. 2, where again the feedback network is indicated in heavy lines.

This is no longer a normal combination of voltage inverse feedback and conventional deflection. Instead, the inverse feedback coupling capacitor and resistor are part of the sawtooth generating circuit, and the blocking oscillator tube is now intimately associated with them. The inverse feedback provides such excellent control of linearity that the usual damping resistors across the yoke are unnecessary. The cost of the improved circuit is actually lower than that of conventional circuits.

Operating Measurements

Detailed measurements were made of the required d-c voltages for full vertical deflection of 65-degree picture tubes operating at 15 kv. Comparatively low voltages are required for both the plate and the screen (180-volt supply). The accompanying waveforms show the results.

The new circuit can provide individually or in combination, compensation for variations in mutual conductance of a tube during life, or variations from one tube to another, and instability in a tube such as the type which produces white lines in a conventional tetrode or pentode circuit, in addition to giving excellent linearity, and stable amplitude.

Interlace Stability

For good interlace, without pairing, it is necessary to make both the amplitude and the waveform of the current in the vertical windings of the yoke identical for both the odd and the even line sweeps. Also, the timing must be accurate so that the alternate sweeps commence with and maintain a timing difference of one-half of a horizontal line time interval *H*.

It is also essential that any stray fields present at the picture tube neck be alike for both the even and odd sweeps.

Ripple voltages, from the power supply, both 60 and 120 cycle, are found to have negligible effect upon the interlace stability since the waveform of the 60 or 120-cycle ripple should not change from the

Deflection Amplifiers

Addition of simple inverse feedback network to vertical deflection amplifier circuit makes vertical linearity and height stability virtually independent of tube transconductance. Modified circuit furnishes full vertical deflection of 65-degree picture tubes operating at 15 kv with 180 volts on amplifier plate

By W. B. WHALLEY, C. MASUCCI and K. HILLMAN

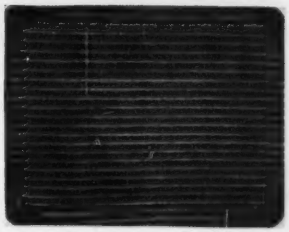
Physics Laboratory
Sylvania Electric Products Inc.
Bayside, New York

odd sweep to the even sweep.

The horizontal incoming synchronizing pulses generated at the transmitter will have no detrimental effect upon vertical deflection since the pulses occur at twice horizontal frequency during the vertical synchronizing period. Of course, it is necessary that the horizontal synchronizing pulses be low in amplitude at the output of the vertical synchronizing filter (high attenuation of 15,750-cycle pulses), otherwise, one of the horizontal synchronizing pulses just preceding the vertical sync period might trigger the vertical blocking oscillator. Since only $2H$ pulses are present during the vertical synchronizing period and the commencement of this period shifts by one pulse from odd to even sweeps, the timing of the even sweep could be very accurately one-half of a line from that of the odd sweep.

However, any horizontal pulses which are locally generated can give severe trouble in interlace if introduced into any part of the vertical blocking oscillator-amplifier circuit. The horizontal pulses in the receiver continue steadily from line to line irrespective of whether it is the odd or even vertical sweep, hence overwhelming the accuracy of the timing of the incoming vertical synchronizing pulses.

As is well known, the horizontal retrace pulse at the anode of the horizontal output tube is of 5 to 6 kv. Hence, the vertical blocking oscillator grid and plate circuits should be well isolated from the horizontal circuits and should have very short and, if necessary, shielded leads.

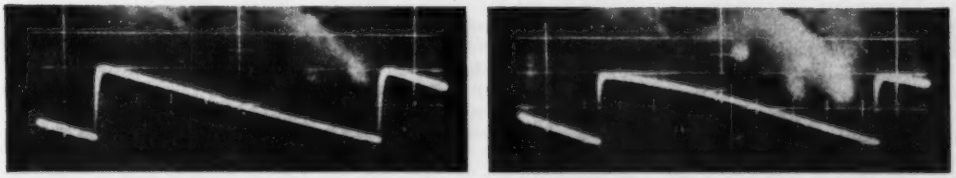


Test pattern illustrates degree of vertical linearity obtainable

The horizontal pulses, even if present at the anode of the vertical output tube, can affect, to varying degree, the timing of the vertical blocking oscillator and the amplitude of the sawtooth. Analysis of the voltages present at the pins of the output and blocking oscillator tubes showed that there was frequently a large horizontal pulse at the anode terminal of the vertical amplifier tube. This pulse comes from yoke coupling between the horizontal and vertical windings when these are not correctly positioned and oriented with respect to each other. By placing a moderate-size capacitor across the secondary of the vertical output transformer, it was possible to reduce the amplitude of the undesired pulse at the plate of the vertical amplifier tube. This gave greatly improved interlace stability in all tests.

REFERENCES

(1) D. G. Fink, Avenues of Improvement in Present Day Television, *Proc. IRE*, p 896, Jul. 1948.
(2) O. S. Puckle, "Time Bases", p 137, John Wiley and Sons, 1951.



Waveform at left shows linearity of vertical sweep with simplified inverse feedback. Sweep with conventional circuit is shown at right

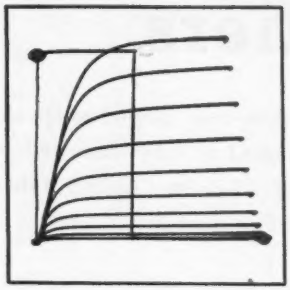


FIG. 1A—Family of I_b — E_b curves for 6AC7 tube. E_{c3}, 150 v; E_{c2}, 0 v; $\triangle E_c$, 0.5 v; E_c, + max. + 1 v; I_b std. 15 ma; E_b std. 100 v; R_k, 75; R_L, 2,700 ohms

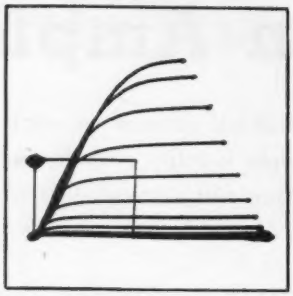


FIG. 1B—Same tube as Fig. 1A. E_{c3}, 150 v; E_{c2}, 0 v; $\triangle E_c$, 0.5 v; E_c+max. +1 v; I_b std. 15 ma; E_b std. 100 v; R_k, 0; R_L, 2,700 ohms

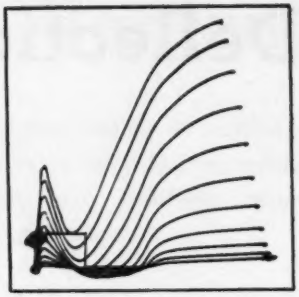
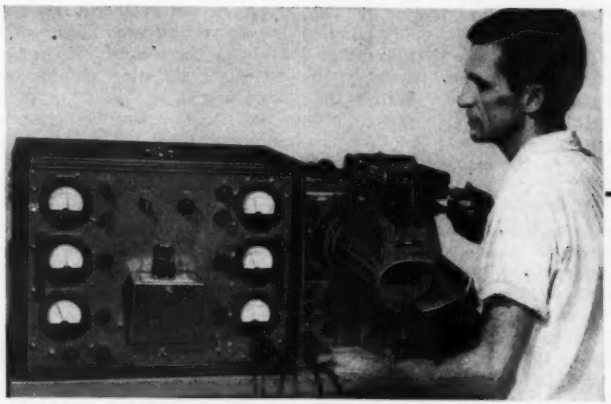


FIG. 1C—Same tube as Fig. 1A. E_{c3}, 150 v; E_{c2}, 150 v; $\triangle E_c$, 0.5 v; E_c+max. + 1v; I_b std. 1.5 ma; E_b std. 50 v; R_k, 75 ohms; R_L, 2,500 ohms

ELECTRON-TUBE

by M. L. KUDER

Electronic Scientist
National Bureau of Standards
Washington, D. C.



Both the curve plotter and the associated cathode-ray oscilloscope take up only the top of a small laboratory table. A Land camera mounted atop the viewing hood produces a finished photograph of the family of curves

THE electronic tube curve generator developed by the National Bureau of Standards makes available the complete static plate characteristics of a vacuum tube. In addition to plotting dynamically a family of I_b — E_b curves, the locus of the load-resistance line is shown.

Because of the continuously stable stationary pattern presented on the cathode-ray tube, a photographic record of the complete family is practicable. With a Land camera, a photographic record is available in one minute. The plate voltage is swept continuously from zero or a small negative value to a positive value. Corresponding to any instantaneous plate voltage, an IR drop that is proportional to the plate current appears across the plate current measuring element. The plate current, represented by the IR drop, and the corresponding plate voltage are applied respectively to the vertical and horizontal deflecting plates of the cathode-ray tube. By repeating this operation in rapid sequence for various values of grid bias, a family of conventional I_b —E_b curves is obtained. In order that the display may be stationary and free from flicker, a power-line-frequency framing rate is included in the instrument.

All test voltages may be varied over a wide range giving the curve generator unusual flexibility. Families of curves for either screen or plate characteristics may be obtained for any fixed value of parameters for the other tube elements. During the test of the high current (low-bias lines of the family), overloading of the tube under test is avoided. When using the conventional point-by-point method it is necessary to keep the high current on continuously a sufficient time to make the meter reading.

The calibration rectangle on the cathode-ray oscilloscope has two adjustable metered coordinates that permit direct measurement of points in the I_b —E_b plane. The locus of the adjustable load-resistance line is displayed and defined by a series of bright dots appearing at the terminals of the I_b — E_b curves.

The unique feature of this instrument lies in the completeness of the data obtained with a minimum of effort on the part of the operator. The generation of such a pattern necessitates a complex cycling of various voltages in a synchronous fashion and with a definitely de-

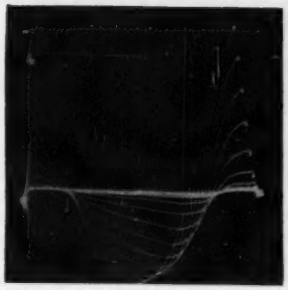


FIG. 1D—Same tube as Fig. 1A. E_{cc} 180 v; E_{cc} 180 v; $\triangle E_{c}$ 0.5 v; E_c + max. +1 v; I_b std. 1 ma; E_b std. 100 v; R_L 330 ohms

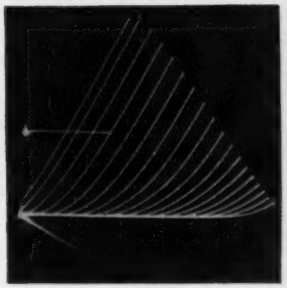


Fig. 1E—Type 6SN7 tube. E_b max. 300 v; $\triangle E_{c}$ 1 v; E_c+max. + 1 v; I_b std. 6 ma; E_b std. 100 v. The value of R_L is 12,000 ohms

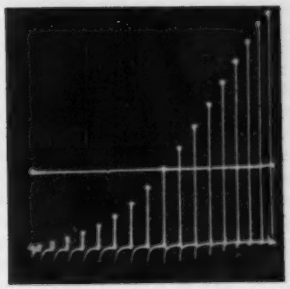


FIG. 1F—Family of I_b — E_c curves for 6SN7 tube. E_b max. 300 v; $\triangle E_{c}$ 1 v; E_c+max. +1 v; I_b std. 7 ma; R_L 12,000 ohms

CURVE GENERATOR

Family of plate characteristic curves is automatically displayed on a cathode-ray screen together with the locus of the load line and coordinates for direct measurement. Receiving tubes can be analyzed with an accuracy of ± 5 percent using a Land camera. Information is obtained in less than two minutes

fined phase relationship. Reliable and stable operation has been achieved by deriving all timing signals from a single oscillator.

Performance Characteristics

Typical results obtained with the electronic tube curve generator are shown in Figures 1A through 1F. The oscillograms were photographed with a 1/25-second exposure at f3.5 on Super XX film. The c-r tube was a 5RP-A with 5 kilovolts between cathode and last anode. Appropriate data is printed under each family.

Curves in Fig. 1A through 1D were obtained by testing a type 6AC7 tube under various conditions. These families illustrate some of the possible departures from the normal handbook curves for this tube. The standard coordinate rectangle, which in Fig. 1A and 1B is 15 milliamperes along the I_b plane and 100 volts along the E_b plane, enables direct measurement of any point on the curve. The locus of the load-resistance line is the terminals of the curves. Curves in Fig. 1A, 1C and 1D were made with a degenerative unbypassed cathode resistor.

Curves in Fig. 1E and 1F were obtained testing a type 6SN7 tube. The curve of Fig. 1F is an I_b — E_c family produced by the existing signals in this instrument. In this curve the horizontal input of the scope is energized by the step-wave grid signal to the tube under test; the vertical deflection results from the normal plate-current sweeps that dwell at their maximum. The resulting dots at the maximums describe a curve whose derivative is the G_m curve. This type of I_b — E_c presentation is particularly convenient in that the grid voltage increments are directly defined by the calibrated vertical bars. The current standard appears as a horizontal bar in this display.

The slight inequality of spacing of the top two lines of the families in Fig. 1 is owing to the change of loading on the E_c cathode follower (V_m in Fig. 3). This is caused by a change to positive-grid-drive condition of the tube under test. The abrupt change in linearity of the E_c driving signal can be accounted for by calibrating the E_c increments in terms of the observed E_c step wave. The E_c step wave presents a linearly spaced increment on either side of $E_c = 0$, but this has a different spacing factor.

In all of these displays, overloading of the tube under test is avoided, since the average dissipation to which the tube is subjected is far below the peak values.

General System of Operation

The electronic tube-curve generator is shown in block form in Fig. 2. All the driving signals originate in the master oscillator (5). The plate voltage excursions for the tube under test are obtained from the oscillator as a large, positive, rising sawtooth wave via (6), (7), (13), and (18). The cathode follower (6) and the e_b maximum control (7) provide a means of controlling the magnitude of the plate-

driving signal without loading the oscillator; cathode follower (13) provides ample driving power for the plate of the tube under test. Cathode follower (13) also performs the important function of isolating power supply (19) for the tube under test from the rest of the circuit. As a result, the only currents passing through R_{L} are the plate current of the tube under test and the plate currents of I_b standard dynamic (20) and I_b standard static (21). The R_L (18) is the adjustable plate load resistor for the tube under test.

Master oscillator (5) feeds a pulse into the pulse former (4) during the interval when the plate-sweep signal, discussed in the previous paragraph, is most negative. Pulses from the pulse former (4) operate a step counter (3) to provide a fixed-bias voltage for the grid of the tube under test. The grid sequentially becomes more positive, rising to a new d-c level each time the plate of the tube under test is driven negative. These stepwise, increasing, bias voltages are fed through the video divider (16) which reduces their amplitude to an appropriate level, and thence through cathode follower (22) to the grid of the tube under test. The E_{g_1} control (14) acting through the clipper (15), provides for manual selection of a calibrated d-c level for the topmost (most positive) grid step, E_c.

Linearizing Circuit

In order that the sequence of grid-step voltages shall consist of uniform increments, a special linearizing circuit is employed. A rather precise equality of grid-voltage increments is obtained through the use of a constant-coulomb capacitor counter, shown by the ring-around path (4), (3), (10), (4). A system of pulsewise inverse feedback effects the transfer of a fixed charge of a capacitor into a larger capacitor with each pulse from the oscillator. The ΔE_c control (17) manually controls the inverse feedback to obtain any desired magnitude of grid-voltage increment.

The output of step counter (3) also feeds into the step number control (9). The step number control (9) can be manually set to deliver a pulse whenever any desired number of steps have accrued. The pulse delivered by step number control (9) signals the electronic switch (1) arresting the entire process.

In its arrested position the electronic switch (1) executes the following: actuates the step reset (2) which discharges the accrued voltage in step counter (3); shuts off the master oscillator (5); and turns on the I_b standard dynamic (20). The I_b standard dynamic (20) subsequently plots the ordinate of the standard rectangle. The magnitude of the I_b standard deflection on the oscilloscope is continuously monitored by a substitution method with I_b standard static (21), a matched tube, and its associated meter.

While the entire circuit is in the arrested state established by the electronic switch (1), a synchronizing pulse finally arrives from the synchronizing pulse amplifier (11). This pulse passes through the path (6), (7), (13), and thence to the E_b standard control (8). This provides an E_b sweep for the I_b standard vertical deflection until this sweep reaches a standard value of E_b selected on the E_b standard control (8) with its associated meter.

At the instant the divorced E_b sweep reaches the value set on E_b standard control (8), the pulse is delivered to the electronic switch (1) turning it on. Since the electronic switch previously had turned on the I_b standard dynamic (20), the signal from the E_b standard control (8) causes the almost instantaneous shutting off of the I_b standard simultaneously with the turning on of the master oscillator (5). This sequence results in the plotting of a standard coordinate rectangle.

Since all the plate voltage sweeps delivered from the cathode follower (13) to the plate of the tube under test pass through the plate-load resistor (18), the IR drop in the R_L (18) is automatically subtracted from the total plate voltage for each curve of the family. Thus, each of the $I_b - E_b$ curves in the family terminates at the load-resistance line. The locus of the load-resistance line is accentuated on the oscilloscope by terminating each of the $I_b - E_b$ curves with a bright dot. The dwell at the load-line intersections of the E_b sweeps is accomplished by the load line clipper (12) associated with the master oscillator (5).

Signal Source

All the signals generated in the instrument shown in Fig. 3 are derived from the rather special form of multivibrator V_{1a} and V_{1b}. The multivibrator has been constructed with multicontrol grid tubes on each side to facilitate its stopping and starting in a particular phase. The time constants of the two oscillating grids of the multivibrator have been chosen to give approximately a ten-to-one ratio, with the long period on the grid of V_{1b}.

The short period on V_{1a} allows for the generation of a relatively narrow positive pulse at the plate of V_{1a}. Resulting from the choice of the long time constant in C_{17}, R_{22}, and P_2, a positive, rising, sawtooth signal having approximately ten times the duration of the pulse from V_{1a} appears at the plate of V_{1b}. The sawtooth output from the plate of V_{1b} is fed through the cathode follower V_{2a}. Cathode follower V_{2a} lowers the impedance level and permits adjustment of the E_b sweep control without affecting the oscillator. The E_b sweep control effects the shift in the d-c level of the a-c signal coming from V_{2a}.

A diode clipper tube V_{3a} with its cathode anchored to a regulated bus clips the sweep from the oscillator to a regulated magnitude for all sweeps. This clipper also effects a desirable dwell of the sweep at its clipped maximum level. The dwell results in the intensification of the load-line intersection points. The clipped and d-c shifted sweep from V_{3a} controls cathode follower V_{3b} enabling V_{3b} to deliver a low-impedance sawtooth signal to the plate of the tube under test. The signal from V_{3b} passes through an appropriate load resistance selected in the associated network connected across terminal R_L. An ohmmeter connected across these terminals measures the value of R_L.

It will be noted that the E_b power supply is disassociated from the rest of the circuit. This power supply serves to energize only the

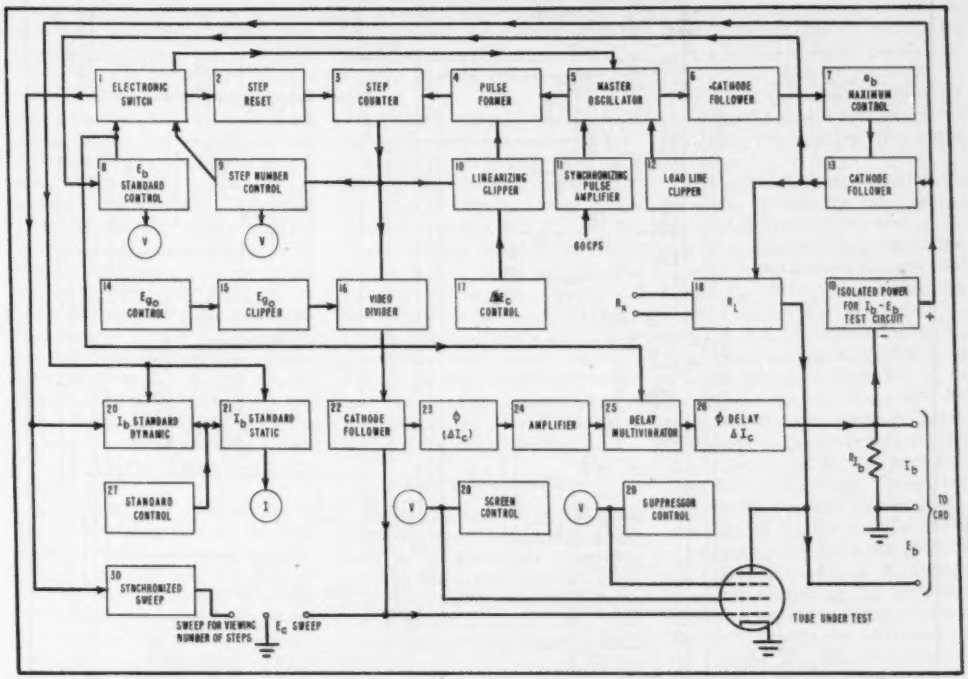


FIG. 2—Block diagram of the electronic tube curve generator. Numbers in the boxes are used for text reference

cathode follower V_{2a} and the two I_b standard current tubes V_c and V_{2b}. The idling current of cathode follower V_{2a} passes through R_{2a}; the output current flows through R_L, thence through the plate-cathode circuit of the tube under test, and thence to E_b power supply through R_{2b}. The IR drop across R_{2b} has special significance in that it defines the instantaneous plate current of the tube under test and the I_b standard plate current of V_{2b}.

Basic Curve Generator

In order to obtain a display of the conventional $I_b - E_b$ curve on a cathode-ray oscilloscope, the IR drop from R_{2a} is applied to the vertical deflection terminals of the oscilloscope while the plate-to-cathode drop of the tube under test is simultaneously applied to the horizontal deflection terminals. Since R_{2a} must be a small resistor, considerable amplification of the vertical signal is required.

The oscilloscope must have broadband amplifiers for both deflections in order that the display will not be distorted by the oscilloscope. Furthermore, any phase-shift in these amplifiers must remain constant during the complete cycle of the family.

It is of particular interest to note that the IR drop across R_{2a} does not produce a first-order degeneration of the maximum plate-supply signal to the tube under test. This follows from the fact that the signal to the grid of V_{2a} is clipped at a constant positive crest by V_{2b}, and thereby, V_{2a} delivers at its cathode a signal whose positive crest is essentially constant with respect to ground. However, due to the differing demands of plate current I_b for the tube under test on each line of a family, the cathode follower V_{2a} cannot deliver exactly the same crest values of E_b even though its input is clipped at a constant crest value of E_b. Furthermore, the tube under test presents a nonlinear loading of V_{2a} due to the wide-range excursion of E_b (cutoff to positive grid values) usually employed.

The effect of such variable loading of V_{2a} is observed in a curvature of the R_L load line dots that should appear as a straight line. Except for this distortion of the load-line locus, the degeneration of the E_b signal as it passes through V_{2a} does not distort the balance of the display.

In the interest of minimizing the distortion of the R_L locus display two criteria are observed, both of which aim at minimizing the nonlinear distortion in V_{2a}. First, the V_{2a} stage should possess a tube having as sharp a cutoff and as high a g_m as is practical; second, R_{2a} should be small, so as to limit the plate-supply degeneration to V_{2a}, which also has a nonlinear degenerating effect on the output signal from V_{2a}.

Linear-Step Generation

The square pulse signal from V_{1a} rises to its positive peak at the time the plate-sweep voltage at V_{1b} goes

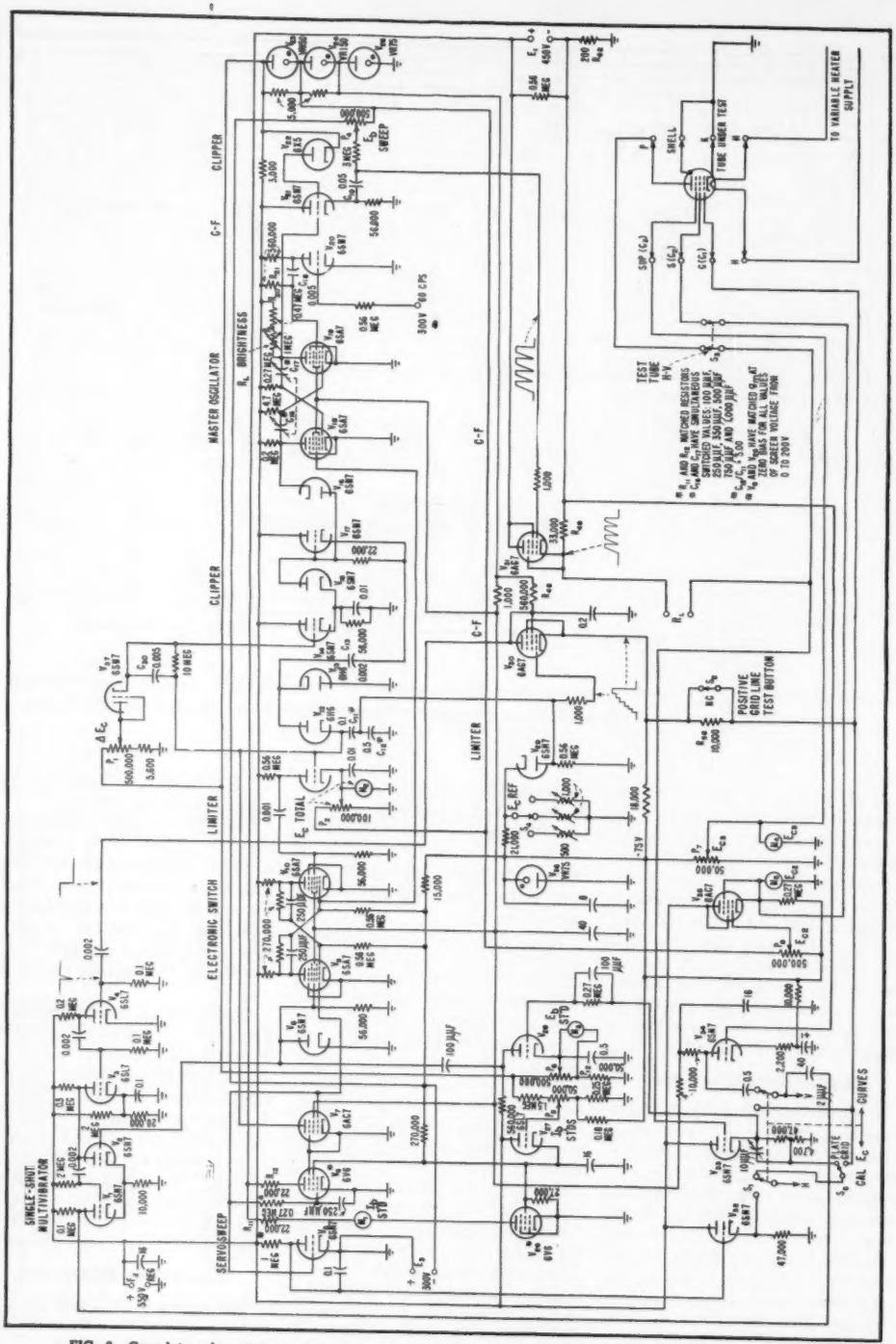


FIG. 3—Complete schematic circuit diagram of the automatic static-characteristic plotter for electron tubes

most negative. This allows the grid of cathode follower V_{17} to follow the positive pulse from V_{18} in a positive direction until the clipper V_{18} arrests it. The positive peak to which this pulse rises before it is arrested by an established voltage on the cathode of V_{18} is determined by the sum of two voltages in series; namely, the manually established potential in C_{20}, (peak derived through V_{17} from the ΔE_c control), and the previously accrued voltage across C_{11} and C_{12} in series.

As this positive pulse rises, current flows from the cathode of V_{17} through capacitor C_{19}, thence through diode V_{12} into the step-accrual capacitors C_{11} and C_{12}. Diode V_{12} serves to restore the output end of capacitor C_{19} to ground potential in the interim between positive pulses.

Neglecting the degeneration of the cathode followers in this part of the circuit, it becomes apparent that the positive crest to which the cathode of V_{17} is allowed to rise increases on each succeeding pulse by the exact amount of the previously accrued voltage at the top terminal of C_{11}. This feedback action results in a change of charge in C_{19} (during each cycle) proportional to the fixed charge in C_{20} selected by the tap on the ΔE_c control. Moreover, this measured change of charge on C_{19} remains the same for every pulse delivered from V_{17}; hence the term constant-coulomb capacitor counter used previously.

The low-impedance output of V_{17} together with the generous pulse width are more than adequate to allow C_{19} to reach the asymptote on its change of charge. The stair-step-function voltage generated in capacitors C_{11} and C_{12} is linearly reduced in amplitude by the ratio of C_{11} to C_{12}. This small-amplitude, step-function signal is fed to the grid of the tube under test through cathode follower V_{20}.

Calibrated Bias

The desired d-c bias for the grid of the tube under test is established through the application of the diode limiter V_{20} with the associated manual control of its cathode potential by the E_c reference control. The diode limiter V_{20} conducts only on the most positive step imparting the necessary bias voltage to capacitor C_{19} so that the grid of the tube under test comes up to a calibrated d-c bias level for the most positive step.

A peak-reading, vacuum-tube voltmeter was connected to the grid of the tube under test when calibrating the choice of voltages for the topmost step in terms of the value of resistors R_{23}, R_{24}, and R_{25}. These resistors of the E_c reference control were so chosen as to provide values of +1, 0, and −1 volts for the topmost step as measured at the grid of the tube under test. It is possible to select other values of voltage for the cathode of V_{20} that would result in any reasonable value of grid limiting up to at least +3 volts for the tube under test.

Frame Synchronizer

Pentagrid tubes V_9 and V_{10} with their associated components constitute a conventional electronic switch. The output control signals from the switch are taken from the No. 1 grids of these tubes. The choice of pentagrid tubes permits complete independence of the two control signals fed in through grids 3 of V_9 and V_{10}.

In an electronic switch of this nature, control grids 3 accept only negative pulses, and these negative pulses are only effective to the tube that is in the conducting state. When a negative pulse is received on grid 3 of this switch, grid 1 of the same side of the switch becomes biased beyond cutoff within a few microseconds. No signal on grid 3 can produce further effect after grid 1 becomes biased. For example, a positive pulse on grid 3 cannot make this side of the switch resume conduction since grid 1 is below cutoff voltage.

The functions controlled by this multipurpose switch will be individually described in time sequence of occurrence. During one cycle when the instrument is generating the family of curves, the electronic switch is in the state that we shall consider the ON or RUNNING position. In the ON position, V_{10} is conducting and V_9 nonconducting; grid 1 of V_{10} is at ground potential.

By interconnecting grid 1 of V_{10} with grid 3 of V_{10}, the oscillator V_{13} and V_{14} is allowed to run freely. Since V_9 of the switch is nonconducting during the ON period, its grid 1 is biased below cutoff. As this grid is directly connected to the grids of V_{15}, V_{16} and V_{17}, the latter three tubes also will be nonconducting during the running time of the oscillator.

The grid-step-function limiter V_{21} generates a negative pulse at its plate when the step function in C_{21} and C_{19} has accrued to a value that overcomes the selected cathode voltage on V_{21}. When the step-function voltage applied to the grid of V_{21} is large in magnitude and when V_{21} is a sharp-cutoff tube, the manually selected cathode voltage for V_{21} is an effective measure of the a-c magnitude of the step-function signal.

Therefore, the control P_3 and its associated meter M_3 are appropriately labeled E_c TOTAL. When the step function reaches the total voltage selected for the cathode of V_{21}, a negative pulse from the plate of V_{21} passes to grid 3 of V_{10} instantaneously triggering the electronic switch to the OFF position. Immediately following the OFF state of the switch, the oscillator is stopped and held in this condition while V_{13}, V_{14}, and V_{17} are rendered fully conducting.

Pentode tube V_{17} presents a low-impedance discharge path for the step-accrual capacitors C_{11} and C_{12} rapidly discharging them to zero voltage. The plate current of dynamic-standard-current tube V_9 produces a pulsed IR drop in R_{32} corresponding to a calibrated value of the plate current of the tube under test. This pulsed IR drop from V_9 results in the I_b standard vertical deflection on the cathode-ray oscilloscope.

Plate-Current Calibration

The calibration of the pulsed current of V_9 is accomplished by a substitution method. A continuous current has been made equal to the peak pulsed plate current of V_9 by selecting V_{26} to match V_9, making R_{31} equal to R_{32}, and applying the same variable screen voltage to both V_9 and V_{26}.

The control grid of V_{26} is grounded while the control grid of V_9 is switched periodically to ground quite accurately by the electronic switch V_9 and V_{10}. The po-

tential from P_5 effects variable control of the screen voltage to V_6 and V_{2b} through cathode follower V_{2T}. The potentiometer P_5 is appropriately labeled the I_b STANDARD CONTROL. The adjustable standard plate current to be selected is read on the I_b standard meter M_1.

Subsequent to a short rest period in the OFF position of the electronic switch, a synchronizing pulse is generated by V_{2a}. An amplified and rectified 60-cycle square wave is generated at the plate of V_{1a}. This signal is differentiated by R_{23} and C_{19} delivering a phase negative transient to grid 3 of the multivibrator tube V_{1b}.

It will be noted that during the OFF position of the electronic switch, V_{1a} of the multivibrator is held in a nonconducting state by a large negative bias on its grid 3; V_{1b} of the multivibrator is in a conducting standby condition until the reception of the synchronizing signal from V_{2a}.

When the signal from V_{2a} rapidly biases off grid 3 of V_{1b}, the plate of V_{1b} delivers a single divorced plate-sweep signal. The signal is normal in every respect except that it occurs in a nonrepetitive fashion in contrast to the normal oscillations of the multivibrator. However, the divorced sweep occurs repetitively at a 60-cycle rate, and is induced directly by the synchronizing pulse from V_{2a}. The single divorced sweep from V_{1b} passes through the previously described path to the plate of the tube under test.

Because the tube under test is biased beyond cutoff, no plate current from it is plotted in terms of an IR drop in R_{46}. During the divorced plate sweep from V_{1b}, the peak pulsed-plate current from V_6 is resting in a steady state and at a calibrated magnitude. As a result, a horizontal bar whose height above the base line directly represents the reading on M_1 (the standard I_b) is plotted on the cathode-ray oscilloscope.

Plate Voltage Calibration

The divorced sweep from V_{1b} progresses until the voltage at the plate of the tube under test, which is also fed to the grid of V_{2b} via V_{2a}, overcomes the bias on the cathode of V_{2b}. At the instant the divorced plate voltage sweep approaches the cathode bias on V_{2b}, a negative pulse from the plate of V_{2b} turns the electronic switch to the ON position.

As the switch goes to the ON position, the I_b standard deflection current is removed from V_6 by biasing off the tube. This results in the closing of a standard rectangle, as displayed on the oscilloscope, whose length is measured by the E_b standard meter M_2.

The potentiometer P_6 and its associated meter M_3 are appropriately labeled E_b STANDARD. Since the plate voltage sweeps are usually large and V_{2b} is a sharp cutoff tube, the cathode potential of V_{2b} as selected on P_6 effectively determines the voltage lengths for the standard rectangle within close limits of error.

The error is essentially a constant, equal to the cutoff bias of V_{2b} subtracted from the reading on M_3. By zero-adjusting M_3 to the left of zero an amount equal to the cutoff of V_{2b} or by applying a bucking potential to the ground end of M_3 equivalent to the cutoff bias of V_{2b}, this error can be negligible. Errors in this part of the circuit owing to time or phase lag of the functions are negligible as compared to other errors.

The delay that occurs between the time the signal is being applied to the grid of V_{2b} and the time it takes the electronic switch to operate and cutoff V_6 is not more than 2 microseconds. With a plate-voltage sweep time of approximately a millisecond, a delay of 2 microseconds will introduce only 0.2 percent error due to time lag.

Accessory Circuits

Two circuits have been included in this design that are not vitally necessary, but add conveniences and confidence in the overall operation of the instrument. Triode V_6 with its associated plate circuitry constitutes a simple servo-sweep. By direct connection of the grid of V_5 to V_6 of the frame synchronizing switch, V_5 derives its servo-timing. The sweep that V_6 generates is especially useful when viewing on the oscilloscope the step-function signal at the grid of the tube under test.

A convenient exchange of the oscilloscope connection from the normal curve-displaying connections to the grid-step function versus the servo-sweep is provided for by S_1. The step function oscilloscope display is used in setting up the E_c total and the ΔE_c controls.

Triodes V_{1a}, V_{2a}, V_{2b}, and V_4 identify those curves in the family that have positive values of grid bias. Whenever the grid of the tube under test is driven positive, an abrupt increase in load occurs on cathode follower V_{2b}. When this load occurs, a pulse is obtained by differentiation of the plate signal of V_{2b}. The pulse from V_{2b} is small since the allowable degeneration value of R_{2b} is small. Therefore, the pulse is amplified by V_3 and V_4 in order to trip the single-shot multivibrator V_1 and V_2.

The multivibrator stores memory of the positive grid lines from the time of the origin of that line at zero I_b and zero E_b until the trace reaches the E_b standard deflection. At the instant the E_b standard deflection is reached, a negative pulse from V_{2a} resets multivibrator V_1 and V_2 causing it to deliver a sharp marker pip. When the multivibrator is coupled very loosely into the vertical-amplifier input connection of the oscilloscope a pip appears on the positive grid lines of the family. The pip is best illustrated in the family of Fig. 1E. It appears on the top two (positive) curves of the family directly above the right-hand end of the standard rectangle.

Resistor R_{2a} may be inserted in series with the grid of the tube under test by depressing the normally closed push button in shunt with R_{2a}. Depressing the button results in clipping of the positive grid steps from the tube under test. On the oscilloscope display of the characteristic family, the clipping results in an obvious compression of the positive grid lines of the family. This compression is another means of identifying the positive grid lines.

Diode V_3 shunts out the positive pulses from V_{2a} that occur during each flyback of the E_b sweep. These positive pulses, if they were not clipped out by V_3, would cause false triggering of the memory multivibrator V_1 and V_2. The result of the false triggering would put a pip on all the lines of the family instead of only on the positive grid lines.

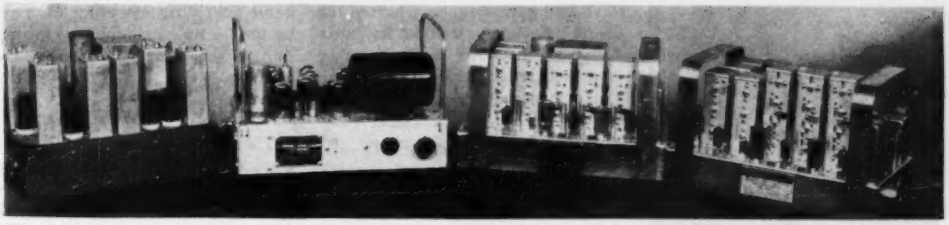


FIG. 1—Mobile f-m receivers during the past ten years (left to right, 1940, 1945, 1948 and present) have undergone considerable electrical improvement without change in physical size and little change in general appearance

Ten Years of Progress In Mobile F-M Receivers

Sensitivity has taken a back seat to selectivity in the design of mobile receiving equipment, especially in the 25 to 50-mc region. Several efficient ways of achieving increased selectivity without increasing size, cost and complexity are outlined and discussed

By A. G. MANKE and R. T. MYERS

Radio Communication Engineering Section
Commercial Equipment Division
General Electric Co.
Syracuse, New York

MOBILE RECEIVERS, for use in the 25 to 50-mc region on f-m, have undergone considerable improvement in the past ten years. This fact is illustrated graphically in the following text and illustrations. One striking point of interest is the lack of major physical design changes needed to obtain so much improvement in performance. A photograph showing first, latest and two intermediate commercial models is shown in Fig. 1.

Changing Requirements

Initially, in this field, the two major problems for the receiver were sensitivity and reliability. However, as the number of users increased, and they really increased rapidly, the receiver problems quickly changed to those primarily related to selectivity. The problems which are, to a large extent, directly related to selectivity are spurious responses, intermodulation, desensitization, oscillator drift, temperature compensation of all tuned circuits, oscillator radiation, image ratio, fidelity, and impulse response of both the low and high i-f amplifiers.

Figure 2A shows the changes in sensitivity that have taken place. The most significant fact these curves reveal is that no appreciable improvement in receiver sensitivity has been obtained since the 1945 receiver.

It is evident that the selectivity characteristics of an f-m receiver are of much importance in predicting performance. No other single characteristic has such a broad influence in determining the final field performance of the receiver and, consequently, of the communication system. The selectivity re-

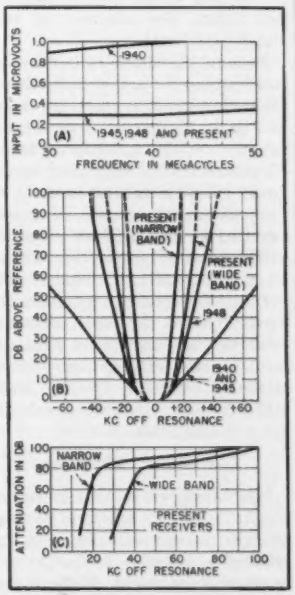


FIG. 2—No appreciable improvement in receiver sensitivity has been realized since 1945 (A) but selectivity has been increased, as shown in B and C

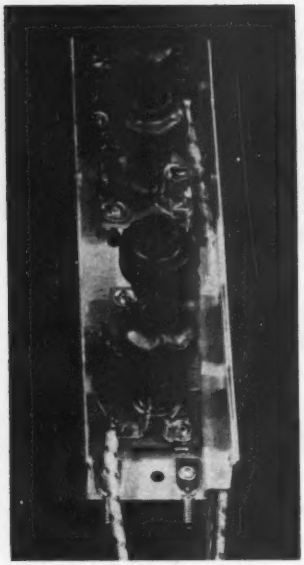


FIG. 3—Quadruple tuning of low i-f transformers provides sharper response curves

ferred to in the above characteristic is not that of the low i-f amplifier but rather the effective or two-signal selectivity.

Figure 2B shows the improvement in selectivity that has followed the evolution of the receivers shown in Fig. 1. These curves were taken by the 20-db quieting method. (Measurement of selectivity by the 20-db quieting method is made by comparing the amount of power required to give a 20-db reduction in the noise output of the receiver on and off frequency.) Dashed lines are used for attenuations above the desensitization threshold, since desensitization occurs above this level, and higher attenuation values, although indicated by the 20-db quieting selectivity curves, actually are not applicable.

Two-Signal Selectivity

The two-signal selectivity curves shown in Fig. 2C take into account all such factors entering into the selectivity question as far as the receiver is concerned. If the transmitters are reasonably free from noise and spurious signals, such a selectivity curve can be used to predict field performance, whereas the 20-db quieting curve does not show the desensitization of the receiver and is not adaptable to predicting performance at the adjacent channel and gives no information whatsoever at several channels off resonance.

In plotting the curves of Fig. 2C a weak signal equal to that required for standard RMA sensitivity is applied for the desired signal (a signal of such strength that the ratio of signal plus noise plus distortion, to noise plus distortion is equal to 12 db at two thirds of rated deviation). A second generator modulated at two-thirds maximum deviation (400 cycles) is used as the interfering generator. For each point on the selectivity curve, the interfering signal is increased until the desired signal suffers to the extent that a distortion meter shows 6 db of signal plus noise plus distortion to noise plus distortion.

Only one side of the two-signal selectivity curve is shown and this is the side having the least selectivity. By plotting the curves this way more space is available for extending the curves to cover several channels off resonance. This then enables one to read the actual selectivity directly from the two-signal selectivity curve for the adjacent channel and for frequencies far from resonance.

The 20-db quieting curve is found to be in error between 6 and 20 db in regard to predicting receiver band pass. In this region the 20-db quieting curve is often thought to represent the band pass of the receiver. This error can best be checked by putting into the receiver a signal twice the 20-db quieting level, modulating the signal at any audio frequency between 300 and 1,000 cps and increasing the swing. (This corresponds closely to maximum output.) This value of swing represents the useful band pass of the receiver, and is slightly greater for higher modulating frequencies.

This method of checking receiver bandwidth is known as the swing or modulation method and agrees with actual field operation, therefore giving realistic results. The wide difference between the 20-db quieting method of measurement of bandwidth at 6 db and the actual band pass characteristics of a receiver for an f-m signal are in part due to the limiting action of the receiver at this level.

Low I-F Amplifier

The latest receiver uses three quadruple-tuned i-f transformers in the low i-f amplifier. One of these transformers is shown in Fig. 3. All circuits are arranged so the coupling can be varied by mechanical movement of the plate and grid coils. The transformer is designed with the idea in mind of readily changing from wide to narrow band by changing a loading resistor on the plate coil, changing one coupling capacitor, and then adjusting the coil spacing as specified for narrow band.

Ceramic temperature-compensating capacitors are used to tune the coils. These capacitors are mounted on rigid terminals which also serve as coil terminals.

The iron cores used in the transformers are adjustable, but once set, a lock washer arrangement prevents further movement.

Figure 4 shows a typical selectivity curve of one of the wide-band quadruple-tuned i-f transformers. It is interesting to note that one of these transformers has several times more selectivity than the entire 1945 receiver. Although the slope of the curve of the amplifier using these transformers is great enough to give a ratio of 2 to 1 between 6 db and 100 db as measured by conventional a-m selectivity methods, this transformer shows very small ringing effects due to

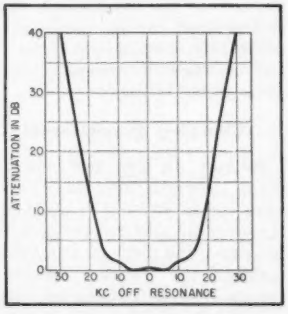


FIG. 4—Selectivity curve of four-coil low i-f transformer

impulse noise. Since each of the transformers is isolated from each other by a tube, the tendency towards ringing of the entire amplifier is held essentially to that of an individual transformer.

The quadruple-tuned transformer, when properly designed, gives a selectivity curve with an inherently wide nose as compared to that obtained in double-tuned i-f transformers. The selectivity curve (Fig. 4) has an appreciably flat portion at the bottom and then has a small shoulder at each side which adds to the broad-band effects obtainable in this selectivity characteristic. The shoulders of this selectivity curve are down only 2 db and give an overall rounding effect to the selectivity curve.

The high i-f amplifier in this receiver consists of a single stage of triple-tuned transformers. These transformers are very similar to the quadruple-tuned units in mechanical construction and also in electrical performance. A single 6BH6 pentode is used with two triple-tuned i-f transformers and this tube is operated at very low plate and screen voltage as the total gain in this amplifier is held to a minimum. It is interesting to observe the selectivity obtainable from a single stage consisting of two triple-tuned transformers and compare this to the high i-f amplifier used in the older receivers using double-tuned i-f transformers instead. The selectivity curve of this amplifier and its predecessor is shown in Fig. 5A. It will be noted that the bandwidth at 6 db is identical for both amplifiers and at 100 kc off resonance the triple-tuned amplifier is already ten times more selective than the double-tuned amplifier.

R-F Amplifier

In Fig. 5B is shown the comparison of the selectivity of the r-f amplifiers of receivers shown in Fig. 1. At one megacycle off resonance the later model receivers have 100 times more attenuation than their predecessors. This was accomplished through the use of multiple circuit transformers. The r-f transformer (Fig. 6) is triple tuned and the antenna transformer (not shown) is a two-circuit preselector. The coils used in these transformers have very high Q's and are tuned with ceramic temperature-compensating capacitors.

Figure 5C shows the comparison of the former single-tuned antenna coil with that of the present double-tuned preselector or antenna transformer. At one megacycle off resonance, the preselector has five times more selectivity than the previous single-tuned antenna coil used in the 1945 receiver. Selectivity in this part of the receiver is extremely important now that the communication band is crowded as this contributes directly to the reduction of intermodulation, except for stations located within the band pass region of the preselector, and also prevents saturation of the first tube when stations are located in close proximity. Higher front-end selectivity also contributes to lower oscillator radiation, less spurious responses and improved two-signal selectivity.

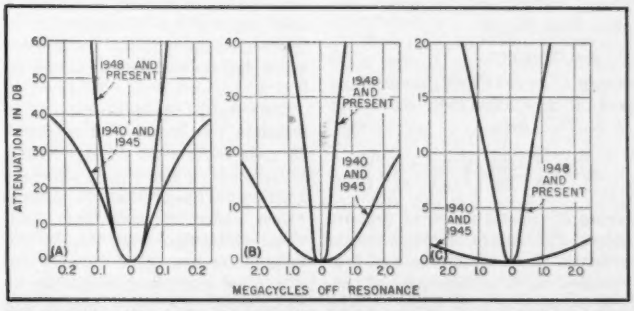


FIG. 5—High i-f (A), r-f (B) and antenna (C) circuit response curves are further evidence of improvement over earlier models

The improvement in image ratio which is largely dependent on r-f amplifier performance has increased from 1,200 to 1,000,000 or from 61 db to 120 db. Oscillator radiation has been reduced from 3,000 microvolts down to less than 20 microvolts. The two-signal selectivity at the alternate channel has been improved from 30 to 90 db. Intermodulation for stations three and six channels removed from resonance has improved from 47 to 76 db. Adjacent-channel (40-kc) desensitization has improved from 15 to 80 db and the alternate-channel (80-kc) desensitization has improved from 40 to 90 db.

Spurious response ratio has been improved from 60 to 90 db, which is

FIG. 6—Triple-tuned r-f transformer

due among other things to front-end selectivity, the use of a mode crystal and chassis arrangement. A far greater improvement than indicated by the ratio of 60 to 90 db has been made in the reduction of the total number of spurious responses present in the receiver. The largest selectivity increase on the later model receivers has occurred in the r-f amplifier and in view of the large number of stations in the band and the tendency towards narrow band which would further increase the number of stations in the band, it is logical that this portion of the receiver should receive the greatest percentage of performance stepup.

The gain of the multiple-coil transformer is inherently high, therefore, making the receiver design very efficient from the standpoint of the number of tubes required. For instance, the latest receiver achieves its improved performance with one less tube envelope.

Measuring UHF-TV

Method combines noise-diode and signal-generator techniques to simplify manipulations and equipment over usual methods and provide greater range and versatility. Allows quick comparison of receiver noise figures and uses only standard laboratory instruments

By S. R. SCHEINER and G. W. CARTER

Television and Broadcast Receiver Division
Bendix Radio Division of Bendix Aviation Corp.
Baltimore, Maryland

NOISE FIGURE of a television receiver is usually measured with a standard noise source, such as a temperature-limited diode. A signal generator can be used instead of the noise diode, but the experimental manipulations and mathematical calculations are more cumbersome.

A method for measuring and comparing noise figure is described which combines the noise diode and signal-generator techniques. In some cases, this method results in the use of simpler manipulations and less equipment than either of the two standard methods.

This system may be applied to the measurement of a uhf converter-vhf receiver combination measurement of noise figure of a receiver beyond the usual range of a noise diode, and rapid comparisons of various receiver noise figures. Through its use receivers can be readily compared as to signal-to-noise performance by measuring gain and noise output into a fixed narrow bandwidth, which information can readily be converted to noise figure if desired.

A convenient definition of noise figure of a receiver is[1,2]

$$F = \frac{S_a/N_a}{S_o/N_o} \qquad (1)$$

where S_a/N_a = the available signal-to-noise power ratio input from the signal source and S_o/N_o = the available signal-to-noise power ratio at the output terminals of the receiver.

Equation 1 can be rewritten as

$$\left(\frac{E_o}{E_{No}}\right)^2 = \frac{E_a^2}{4KTBR_aF} \qquad (2)$$

where E_o = the signal voltage output of receiver, E_{No} = the noise voltage output of receiver, E_a = the open circuit signal voltage from the source, R_a = the impedance of the source, K = Boltzmann's constant (1.38×10^{-23} joules per degree), T = absolute temperature in degree Kelvin, and B = noise bandwidth of receiver.

From Eq. 2, the signal-to-noise output ratio of a linear receiver is a function of signal input, source impedance, noise bandwidth, absolute temperature, noise figure; and, in the case of amplitude modulation and detection, the percent modulation. If the noise bandwidth of two receivers is exactly the same, and if the applied signal is modulated by the same percentage, then it is possible to calculate readily the noise figure of the second receiver, having measured the noise figure of the first receiver (with a noise diode), and the signal input required for a convenient signal-to-noise output for each amplifier.

To compare the noise figure of amplifiers designed for the same source impedance, and having the same overall system bandwidth, then from Eq. 2

$$F = CE_{No}^2/G^2 \qquad (3)$$

where $C = 1/4KTBR_a$, a constant, and G = voltage gain of receiver $= E_o/E_a$. Also

$$F_2 = F_1\left(\frac{E_{N2}}{E_{N1}}\right)^2 \times \left(\frac{G_1}{G_2}\right)^2 \qquad (4)$$

where F_1 = noise figure of first receiver, F_2 = noise figure of second receiver, G_1 = voltage gain of first receiver, G_2 = voltage gain of second receiver, E_{N1} = noise voltage output of first receiver, and E_{N2} = noise voltage output of second receiver.

Therefore, if the noise figure of one receiver is known, the relative gains of both are known, and the relative noise outputs of both are known, the noise figure of the other receiver can be calculated.

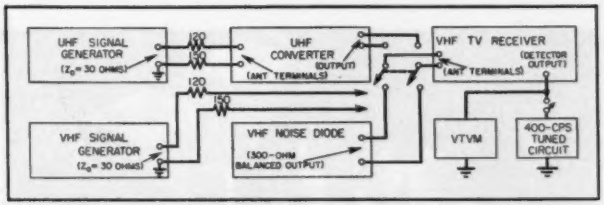
Measurement Procedure

Only one measurement with a noise diode is required on a television receiver at one frequency. It is then possible to calculate rapidly the noise figure of any other receiver at any frequency without further use of a noise diode and without calculation of noise bandwidth B.

A signal generator modulated with 400 cycles and a narrow-band voltmeter are employed in the measurement. The bandwidth of the meter is appreciably less than any of the receivers or amplifiers being compared. Hence, the overall bandwidth will be determined by the meter and will be the same for all receiver measurements as required in Eq. 4. Thus, different receivers fed from the same source impedance can be compared directly and rapidly by measurement of gain and noise output. The various noise figures can be calculated by Eq. 4.

Effectively the procedure is to evaluate the constant C in Eq. 3 by measuring noise figure, (with a noise diode) noise output and gain (with signal generator) for one receiver under one operating condition. Noise figure can then be calculated for any other receiver and any other operating conditions by measuring only noise output and gain, since C remains the same

Receiver Noise Figures



Arrangement of test instruments for measuring uhf-tv receiver noise figures

under the imposed conditions.

The noise figure of a receiver at different frequencies and different agc conditions can likewise be determined by measurement of gain and noise output. In many cases, determination of high noise figures beyond the useful range of the noise diode is possible.

Typical Case

For a practical example, it is desired to measure the noise figure of a uhf converter-vhf television receiver combination where both are designed for 300 ohms input impedance. A noise diode for uhf is not available, and, in addition, the noise figure of the combination is beyond the calibrated range of most commercial instruments.

The block diagram shows the test set-up. The first step is to measure the noise figure of the vhf receiver on the channel to be used for conversion. The usual precautions to insure detector linearity must be observed[3,4]. Using a noise diode, and with the receiver tuned to vhf channel 10, a measurement of 17 db or 50 times was obtained.

Next a c-w signal is applied to the receiver under test. A vtvm is connected to the output of the detector. The carrier input is increased until there is no further increase in noise output to insure linear operation of the detector. Further, the i-f amplifiers are biased to prevent overload in these stages and thereby insure adequate carrier-to-noise ratio at the detector. The noise voltage measured was 0.1 volt.

The signal generator is next modulated with 400 cycles. The percent modulation is sufficiently low to provide adequate carrier to 400-cycle signal voltage to again insure detector linearity. With a 400-cycle filter inserted to remove the noise, the 400-cycle output measured 0.135 volt, using approximately 10-percent modulation. The input carrier level from the signal generator was maintained constant at 80 μv on the measurements. Measurement of signal input, noise output, and 400-cycle output was repeated using a uhf signal generator connected to the uhf converter-whf receiver combination. The percent modulation used must be exactly the same.

A method of determining that the percent modulation is the same in both cases, is to apply a strong signal and reduce the gain so that the output noise is negligible, and with the same d-c voltage at the detector in both cases, measure the audio output. It should be the same if the percent modulation is the same.

With the uhf signal generator operating at 650 mc, the noise reading on the vtvm was 0.1 volt, and the 400-cycle output was 0.126 volt. The signal generator input was 350 microvolts.

Then if E_1 = 400-cycle output in first case, E_2 = 400-cycle output in second case, S_1 = signal input in first case, and S_2 = signal input in second case

$$\frac{G_1}{G_2}\ (\text{Eq. 4}) = \frac{E_1 S_2}{E_2 S_1}$$

Substituting in Eq. 4

$$F_2 = F_1 \left(\frac{E_{N2}}{E_{N1}}\right)^2 \times \left(\frac{E_1 S_2}{E_2 S_1}\right)^2 \qquad (5)$$

In the example mentioned F_2 = 1,100 = 30.4 db, which is the overall system noise figure.

The noise figure of the converter alone can be calculated, if its available power gain is known, as follows: $F_c = F_2 - (F_1 - 1)/W$ where W = available power gain of converter, and all other notations the same.

Indicators

The Ballantine Model 300 Voltmeter serves very well as the indicating device. The meter need not be linear as it can easily be calibrated.

The actual noise bandwidth of the overall system (which is the meter bandwidth) can be calculated by substitution of our measured values in Eq. 2. By this method B can be calculated to be 141 kc.

The measured 3-db bandwidth of the meter with its associated cable fed from a source impedance equal to the detector load impedance was measured to be 125 kc.

Measurements of noise figure for various television receivers can be made without any reference noise diode measurement if the noise bandwidth of the narrow-band meter is calculated. Having evaluated the noise figure of one receiver after this noise bandwidth has been once determined, the same meter can be employed for measurement of noise figure of any other receiver without any determination of receiver bandwidth making use of Eq. 4. As long as the same narrow-band meter is determining the system bandwidth, we are comparing receivers of equal bandwidth and Eq. 4 is applicable.

The authors wish to acknowledge the assistance of J. M. Miller, Jr., chief engineer of Broadcast Radio and Television Engineering Dept. of Bendix Radio. His suggestions and criticisms were of material help in this development.

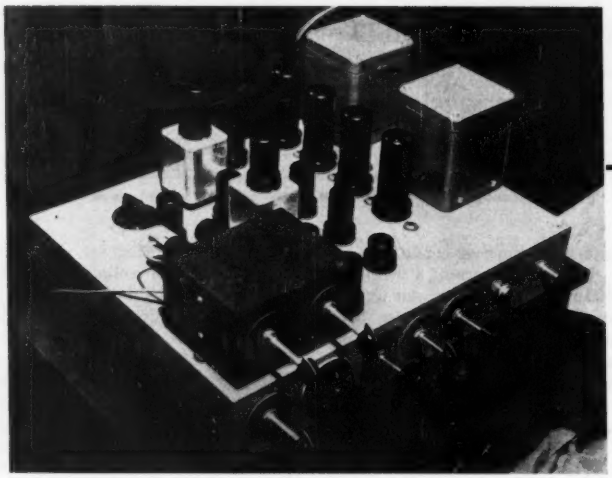
References

(1) H. T. Friis, Noise Figures of Radio Receivers, *Proc. IRE*, p 419, July 1944.
(2) Harold Goldberg, Some Notes on Noise Figures, *Proc. IRE*, p 1,205, Oct. 1948.
(3) E. G. Fubini and D. C. Johnson, Signal-To-Noise Ratio in AM Receivers, *Proc. IRE*, p 1,461, Dec. 1948.
(4) I. J. Melman, Noise Generators and Measuring Technics, *Tele-Tech*, May, June, July and Sept. 1950.

40-DB FEEDBACK

By BENJAMIN B. DRISKO
Massa Laboratories, Inc.
Hingham, Mass.

and R. D. DARRELL
New York, N. Y.



Top view of home-built Drisko power amplifier. A phonograph preamplifier and a dynamic-noise-suppressor circuit are included on the same chassis in this photograph

MAXIMUM ECONOMY together with maximum quality of reproduced music are the two criteria of the audio amplifier to be described. Five years of operation by the designer have shown it to be consistent and trouble-free. Since first emphasis was on satisfying acoustic output, horn-loaded loudspeakers were employed to achieve reductions in power-handling requirements. With such relatively efficient loudspeakers, no more than 12 watts is needed from the amplifier.

Characteristics

The amplifier design calls for effectively zero output impedance and distortion. With the extreme transient demands of symphonic music in mind, the gain-bandwidth requirements are not confined to flatness over the audible spectrum but are extended to provide slopes not steeper than about 6 db per octave down to zero gain outside that range, involving frequencies possibly as low as a fraction of one and as high as 200,000 cps.

Characteristics of the amplifier are closely shaped by those of the overall system for which it was developed. The latter is shown first in block-diagram form in Fig. 1 followed by schematic diagrams of the switching, control, input and frequency-dividing circuits, Fig. 2. The designer's own phonograph preamplifier equalization circuit is not shown as it has been described elsewhere.[1]

Particular attention should be called to the specification of horn-loaded loudspeakers, utilizing an exponential horn for the tweeter and a folded-horn enclosure for the woofer. It should be noted that the amplifier itself, identical in both channels here, is applicable to single-channel use. In this case, the quality is somewhat degraded if L-C crossover filters are employed at the inputs of multiple or coaxial speakers and the acoustic power output from a single direct radiator is markedly reduced.

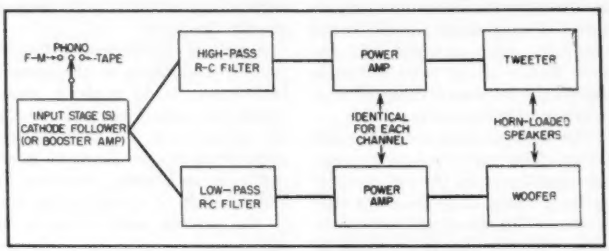


FIG. 1—Block diagram of the dual-channel system

Amplifier Circuit

The distinctive features of the amplifier circuit shown in Fig. 3 are: beam-power output tubes with exceptionally heavy feedback, direct-coupled over two stages only, a somewhat novel method of screen-voltage feed for the output tubes and the complete omission of screen and cathode bypass capacitors.

The principal purpose of the first feature is to achieve effectively zero output impedance. The second and third features enable the advantages of beam-power output tubes to be exploited without the high-signal-level rectification effects normally encountered unless excessive precautions are taken in power-supply regulation and in push-pull balancing. In addition, these features provide the more familiar beneficial effects of large amounts of feedback, a high degree

AUDIO AMPLIFIER

High fidelity is obtained in this audio system by using two amplifier channels, one for a horn woofer and the other for a horn tweeter. Heavy feedback gives effectively zero output impedance. Screen and cathode bypass capacitors are completely omitted

of differential balancing and notably improved transient response.

No provision is made in the circuit for the manual-balancing adjustments popular in current push-pull circuits. With ordinary care in selecting components, inherent self-balancing is provided by the common voltage-feed resistors for the paired 6SJ7 and 6L6 screens, the absence of cathode and screen bypasses and the large amount of feedback used.

Direct Feedback

Although a high-quality output transformer is specified, it is excluded from the feedback loop, which includes only the output and driver stages direct-coupled via 120,000-ohm resistors. The principal reason for this is the relative ease with which as much as 40 db of feedback can be obtained over the entire useful frequency range without running into phase-shift difficulties. Another reason is the elimination of high-frequency oscillations and distortions which are serious dangers whenever feedback is drawn from a transformer secondary.[2]

From the various popular types of phase inverters, the split-load version was chosen both for its simplicity and its operational advantages. Perhaps its only real disadvantage is the danger of heater-cathode leakage noise, which seldom proves serious and ordinarily may be avoided by judicious tube selection.

The specification of 0.5-μf coupling capacitors and 270,000-ohm grid resistors within the feedback loop and 0.01-μf, 2.2-meg combinations outside it may seem odd. Actually, the extremely large time constant of the first combination is essential to prevent steepening the 6-db-per-octave slope below the useful frequency range. The other combination is fully adequate for the lowest frequencies that can be reproduced by the overall system.

The 2.2-meg grid resistors are used because heavy feedback permits satisfactory performance from tubes operated considerably below their maximum dissipation ratings, which in turn usually results in freedom from the grid-current troubles commonly associated with high values of grid leaks.

Overload safety margin is provided by the 12-db greater signal-voltage-handling capacity of the intermediate stages over that of the output stage. With such protection and the 40-db of negative-voltage feedback, distortion of all kinds is truly negligible right up to the output stage's overload point. Just below that, an input signal of 4.6 volts rms on the phase inverter's grid delivers about 12 watts into the associated voice coil.

Amplifier output noise is negligible. With proper adjustment of the a-c heater-supply biasing controls, shown in Fig. 4, total system noise can be held to better than 90 db below full-load output.

Working-Load Considerations

The insistence on as much as 40 db of feedback to achieve effectively

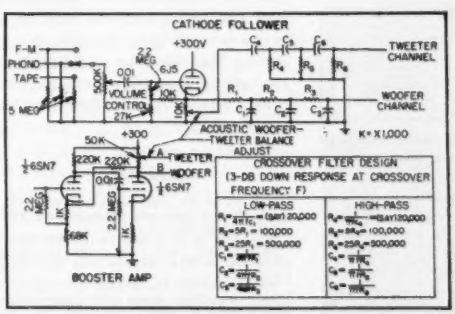


FIG. 2—Amplifier-input and dividing-network schematic. Leads *A* and *B* may be reversed if the woofer is more efficient than the tweeter

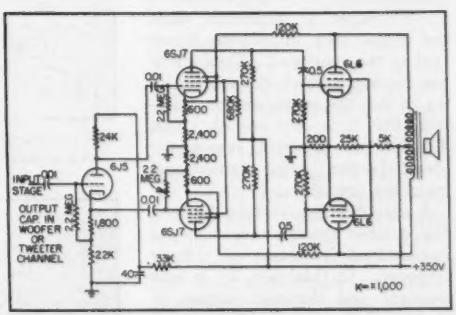


FIG. 3—Power-amplifier schematic. Output transformer may be Langevin 317-A, Peerless S-230-Q, Partridge CFB, Acrosound 20-280 or equivalent

zero output impedance hardly can be justified by the objective of maximum power output within arbitrary limits of permissible distortion. The idiosyncrasies of the actual load involve decisive design considerations, above all in determining the most effective value of amplifier-output impedance.

Efficiency of the particular loudspeaker used is a vital factor. When the working load is the loudspeaker equivalent of a four-terminal T network (consisting of one electrical and one acoustical mesh), the significance of generator impedance is determined by the nature of the coupling between these meshes. The closeness of coupling in general is related to the efficiency rating.

With loudspeakers of less than 10-percent efficiency or with voice coils of high d-c resistance, relatively slight damping can be obtained through reductions in generator impedance. With higher efficiencies and lower d-c resistances, the damping effect of source-impedance reductions becomes progressively more important. Levine[3] recently has proved that, for horn-loaded loudspeakers, critical damping cannot be obtained by normal electronic means until the efficiency reaches 50 percent, at which level the requirement is zero source impedance.

This approach also can be illustrated by shifting the objective for source-sink impedance matching from maximum-power transfer to maximum flatness of voltage response. In the former case, a resistive load is made equal to the generator impedance and the mismatching of a varying load, such as a loudspeaker, is minimized when the mean load impedance equals that of the generator. Even allowing for a mismatch ratio range of 0.4 to 2.5, the output-power variation, Fig. 5, is only one db. This discloses no apparent reason for dissatisfaction with conventional matching procedure.

A very different picture appears, Fig. 6, when the same basic data is re-examined in terms of voltage response. In this case, E_s is held constant and the load voltage is plotted as R_L varies. If the mean load resistance equals R_g, a mismatch ratio range of 0.4 to 2.5 results in an E_L variation of eight db. Even if the minimum load resistance is about 2.5 times the generator resistance, which is likely with amplifiers using triodes without feedback or beam-power tubes with moderate feedback, there still is at least a 3-db variation in E_L.

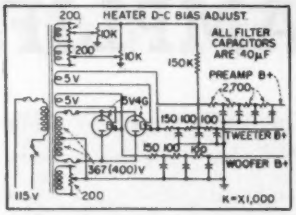


FIG. 4—Power-supply schematic. Use of filter chokes is avoided

If the goal is set as high as ±0.5-db load-voltage variation, Fig. 6 shows that the minimum value of R_L must be at least ten times R_g. This is merely another way of saying that practically constant voice-coil voltage is achieved when the power-amplifier output impedance is reduced to one-tenth the minimum impedance of its working loudspeaker load.

While there is nothing novel in this conclusion, the actual values of required negative-voltage feedback are not generally realized. When calculations are based on the minimum rather than the mean loudspeaker-load impedance to be encountered throughout the operating frequency range, from 15 to 20 db of feedback is required to approximate zero amplifier-output impedance for a triode output stage. For pentodes or beam-power tubes, this value is increased to from 35 to 40 db. The triode figures are confirmed by Williamson[4], who emphasizes that little if any audible improvement is gained by more than 20 db of feedback in his triode amplifier.

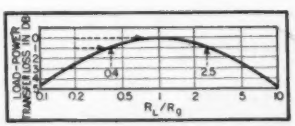


FIG. 5—Ratio of generator resistance to load resistance versus load power

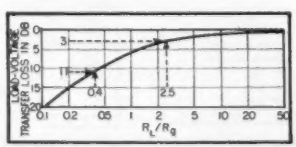


FIG. 6—Ratio of generator resistance to load resistance versus load voltage

Tube and Filter Choices

The less exorbitant feedback demand of triodes is an advantage that probably nullifies the familiar drawback of higher driving voltages. The decisive disadvantage is the seldom fully appreciated problem of high-signal-level rectification effects. In most triode output stages, a fast-acting milliammeter in the plate circuit reveals that extreme signal peaks may cause up to 50-percent rises in the plate current. These rises may cause consequent fluctuations in the supply voltage if the latter does not have effectively zero source impedance.

With pentodes or beam-power tubes, there is a more practical and decidedly cheaper solution. For any given value of load resistance, there is a critical value of screen-supply regulation that effectively eliminates plate-current changes. By feeding the output screens as shown in Fig. 3, variations in screen voltage with signal-level changes tend to hold the plate current and the proper operating point constant.

Since conventional bypassing would limit the speed of screen-voltage fluctuations, transient response considerations call for the elimination of any time constant to provide instantaneous regulation. For the same reason, cathode as well as screen bypasses are omitted, a step that has the additional advantage of markedly increasing the feedback's inherent differential balancing ability.

References

(1) P. W. St. George and B. B. Driskó, Versatile Phonograph Preamplifier, *Audio Engineering*, March 1949.
(2) A. Peterson and D. B. Sinclair, A Single-Ended Push-Pull Audio Amplifier, paper delivered at March 1951 meeting of the IRE.
(3) I. Levine, Generator Impedance of Power Amplifiers Used with Horn-Loaded Loudspeakers, paper delivered at May 1951 meeting of Acoustical Society of America.
(4) D. T. N. Williamson, "The Williamson Amplifier," Iliffe and Sons, London, England, 1950.

Circuit Stability in Guided Missiles

Proper circuit design avoids erratic performance by controlling such factors as grid emission, variation in contact potential, heater-cathode leakage and shock and vibration dangers. End result is circuit with maximum reliability

By R. L. KELLY

Manager
Application Engineering Field Group
Tube Department
Radio Corporation of America
Harrison, New Jersey

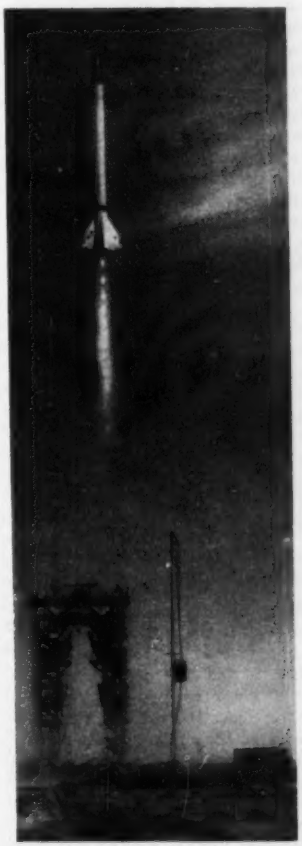
TUBE MANUFACTURERS and circuit engineers have many mutual problems.

The tube manufacturer is often asked to provide tubes that will operate with maximum reliability in circuits and under conditions for which very little information is available. The circuit engineer is asked to design circuits using any one or more of a large number of available tubes about which there is usually a great deal of published information available, but not always enough to cover the peculiarities of a particular circuit application.

The mutual problem is for the circuit engineer to tell the tube manufacturer as much as he can about a proposed application and for the tube manufacturer to tell the circuit engineer as much as he can about the use of tubes in that same application.

Electron tubes are complicated devices and new applications come about continuously. The following paragraphs will deal with recommended solutions to typical problems concerned with more reliable tube performance.

The heart of the electron tube is its cathode. It provides the electrons which are controlled and utilized by other tube electrodes. Thus, it should be expected that factors affecting the normal function of the cathode will have a marked effect on the overall performance of the tube in any particular circuit application in which the tube may be used.



U. S. Navy's Viking Rocket as it leaves the launching site for a 135-mile trip into space

Rectifier Considerations

First, consider the case of a diode. For convenience, look at a rectifier in a power supply, Fig. 1. The ratings for such a rectifier tube give a maximum value of d-c output current, peak-inverse plate voltage and peak plate current. The first two factors are easily measured in a typical circuit but the steady-state peak plate current normally must be checked by means of an oscilloscope.

Many cases of rectifier failures have been traced to the condition of excessive peak plate current, although the d-c output current and peak-inverse plate voltage were well within the manufacturer's established ratings.

How do such designs come about? Usually, the designer is trying to get the required d-c output current and voltage in the most efficient manner. He, therefore, prefers to design a power transformer having low leakage reactance and plenty of copper in order to keep the heat down. True, he winds up with a very efficient system but such designs often lead to excessive peak

plate-current values in the rectifier.

The typical operating conditions for the 6x4 show that for a 4-μf input filter capacitor the minimum value of effective plate-supply impedance per plate is 150 ohms. If a larger value of input filter capacitor is used, a different value of effective plate-supply impedance will be required to limit the steady-state peak plate current to its maximum rated value. For maximum reliability, it is imperative that the value of peak plate current be kept within ratings even if it means sacrificing transformer efficiency or obtaining poorer regulation in the power supply.

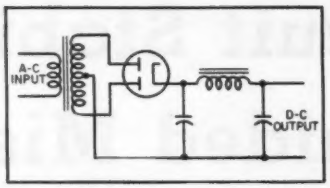


FIG. 1—Typical rectifier power supply with filter components

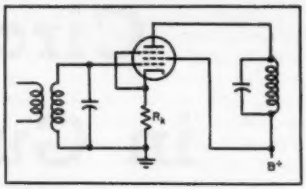


FIG. 2—Pentode circuit in a typical i-f amplifier

Contact Potential

The significance of contact potential may be described as the effect of a small battery in the grid-cathode circuit of a tube; the cathode may be considered the positive battery terminal, the grid the negative terminal. It is ever present and subject to variation due to such factors as time and temperature.

Since contact potential is a function of cathode temperature, variations in heater voltage will change its value. Let us refer to such changes as short-time changes. If performance is detrimentally affected by short-time changes in contact potential, regulation of the heater-voltage supply will reduce the short-time variations. Obviously, constant heater voltage would result in no short-time variations of contact potential. There are many applications, such as in large computers, where it is perfectly practical to use a well-regulated heater supply. In applications where it is impossible to regulate the heater supply, the design engineer must recognize that changes in heater voltage will cause changes in contact potential. This fact is inevitable.

Contact potential varies with time. This variation can be greatly minimized for high-mu tubes by the burning-in period applied to certain reliable tubes. Even so, tubes will exhibit some changes in contact potential during life.

By proper choice of circuit elements and operating voltages, the effects of contact-potential variations may be minimized. Consider, for example, the case of a pentode operating in an i-f amplifier. It is common practice to use cathode bias as shown in Fig. 2. However, the design engineer will often choose a low value of R_k in order to get high g_m, of course staying within plate and screen dissipation ratings for the tube. From the standpoint of tube life, such a design is satisfactory. However, in many cases, the resultant bias, as determined by the drop across R_k, will be 1 volt or less. Since the value of contact potential is in the same order of magnitude, the effective bias on the grid may be zero or actually positive. If the grid operates with a positive bias, grid current will flow, thus loading the input circuit and causing a loss in circuit gain.

The solution of such a problem is simple: increase the value of R_k. True, some reduction in g_m will result, but in many cases the overall circuit gain will increase due to the reduction of circuit loading. Furthermore, with a larger value of cathode-bias voltage, the effects of variations of contact potential with time and heater-voltage variations will be minimized.

Grid Emission

Consider the control-grid circuit alone. Barium evaporates from the surface of the cathode during the life of a tube. The control grid is close to the cathode and operates at a lower temperature. Barium vapor from the cathode may condense on the surface of the control grid. Since the control grid is close to the hot cathode, it absorbs heat radiated from the cathode and as a result its temperature is elevated. Sufficient barium may be deposited on the grid so that, at its operating temperature, it becomes a source of primary electrons. Since the grid is operating at a negative potential with respect to the cathode, its electron emission current will flow to the cathode and to other more positive tube electrodes. This current will return to the grid through the external grid circuit.

A typical grid circuit is shown in Fig. 3. Normal grid bias, in this case, is suppled by the drop across R_k. Since the grid is now an emitter, its current flowing through R_g results in a drop across R_g which is of opposite polarity to the drop across R_k. The resultant grid-cathode potential is the algebraic sum of the drops across R_g and R_k and is less than the drop across R_k. In other words, grid bias is lost.

The effects of loss of grid bias may cause circuit gain to change and, since the action is regenerative, plate current run-away may be caused.

Recognizing this problem, tube designers coat grids associated with large cathodes with some material to reduce the tendency of the grid to emit. However, the circuit designer can also help by reducing the value of R_g. Again, a compromise must be faced. The circuit engineer is always striving to get maximum performance from his circuits. The use of large grid resistors usually improves circuit gain. For maximum circuit reliability, however, a lower value of grid resistor should always be considered. Use as low a value as possible.

Secondary Grid Emission

There is another form of grid emission which must be recognized by the circuit engineer and that is secondary grid emission. It manifests itself in applications in which the grid is driven into the

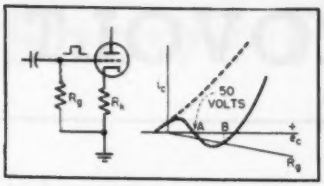


FIG. 3—Grid circuit pulsed in a positive direction

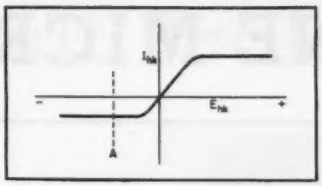


FIG. 4—Typical heater-cathode leakage characteristic

positive region. A typical example will be found in transmitter applications involving class-C operation of the tubes. In such cases, during the time the grid assumes a positive potential with respect to the cathode, electrons from the cathode will be attracted to the grid. Most materials, when bombarded by electrons, give off secondary electrons, and a grid is no exception. Some of these secondary electrons will return to the grid, but others will join the stream of electrons from the cathode and go to the plate or other more positive electrodes.

Flow of secondary electrons from the grid is in opposition to the normal flow of electrons from the cathode to the grid during positive grid operation and, therefore, the current in the grid circuit is less than it would be if there were no secondary grid emission.

Emission Effect

The effect of secondary grid emission is to make the tube easier to drive. Design engineers who provide just sufficient drive voltage to develop the required power output may find they have used tubes having secondary grid emission in their design work. However, when tubes with less active grids are used there is insufficient drive available and low power output results. In the design of such equipment, an excess of driving voltage should be always provided.

While the foregoing example might leave the impression that secondary-grid emission is always desirable, such is not the case. Consider a grid circuit pulsed in a positive direction. Figure 3 shows such a circuit and also the grid characteristic. The dotted curve is the normal diode characteristic of the grid. The solid curve shows the effect of secondary emission. In general, such a curve will cross the axis at about 40 to 50 volts. If a signal is applied which drives the grid past point *B*, the intersection of the grid load line with the curve, the tube will block at point *B*. That is, when the signal is removed, the grid will remain at the potential of point *B*.

Recognizing the desire of circuit designers to use high values of grid resistors, tube manufacturers try to keep secondary grid emission of low-power tubes to a minimum. However, the best insurance is never to drive the grid in the negative-current region.

Heater-Cathode Leakage

Another common source of trouble in the grid circuit of electron tubes is heater-cathode leakage. No problem could exist if the heater and cathode were operated at the same potential. Another method of eliminating the effect of heater-cathode leakage is to use fixed grid bias or gridleak bias. If cathode bias is required, a large bypass capacitor across the cathode resistor will reduce the effect of leakage currents. Where an unbypassed cathode resistor must be used or where the application demands extreme freedom from heater-cathode leakage effects, use of heater-cathode bias is recommended.

Figure 4 shows a typical heater-cathode leakage characteristic. If operation is at or near zero E_{hk}, any small voltage variation results in a large change in I_{hk}. However, if the operating point is moved to *A*, changes in E_{hk} result in much smaller changes in I_{hk}. This method is often used to reduce hum in high-quality high-gain amplifiers. A bias with respect to cathode of about 40 or 50 volts is recommended.

In applications which subject the tube to shock or vibration, shock excitation of the tube electrodes often results. Any motion of one electrode relative to another will result in a variation in output current.

These variations are greater for electrodes spaced close together, such as the grid and cathode. In radio-receiver parlance, this effect is referred to as microphonics.

When faced with a design in which the tube may be subjected to vibration, the designer should utilize some form of shock mounting to reduce, as much as possible, the magnitude of the vibration at the tube.

It is wise to choose a tube having wide spacings between cathode and grid. Here, again, a sacrifice of high gain per stage to obtain utmost reliability is necessary.

Another help in reducing microphonics is to utilize a damping device on the tube. This is a very old trick and has recently been used successfully in connection with the 6J6 oscillator tube in many modern television receivers.

One of the most effective means of obtaining reliability in equipment using electron tubes is often overlooked. This oversight has resulted in many instances of poor equipment reliability.

Heater Voltage

It is strongly suggested that tubes be operated at their rated heater voltage. Operate a tube with 6.3 volts at its heater terminals, if the tube is rated at 6.3 volts. The general assumption that tubes may be operated at ± 10 percent of rated heater voltage assumes that, with the tube designs centered at 6.3 volts, for instance, operation at minus 10 percent will not cause serious loss of emission or output. Conversely, if operated at plus 10 percent, the life of the tube will not be substantially shortened.

This approach was based on radio service for the entertainment field. However, in many high-power transmitting tubes, the suggested permissible range is ± 5 percent while, in some cases, adjustable heater supplies are recommended.

ONE MICROVOLT

Simple design, ease of use and reliability are features of a-c measurement system for input signal of less than one microvolt in magnitude. Complete shielding of a separate input transformer reduces pickup noise to an acceptable value

By H. C. THOMAS and C. W. HEWLETT, JR.

Meter and Instrument Engineering Divisions
General Electric Company
Lynn, Massachusetts

A RECENT NEED to measure a sixty-cycle signal of less than one microvolt in magnitude was not satisfactorily met with commercially available equipment. To fulfill this need, a measurement system was developed which is quite simple in design, easy to use and which has given very reliable service. The system has a full-scale sensitivity of one microvolt, with a precision of ±0.05 microvolt and an input impedance of 50 ohms at 60 cycles.

Influence of Noise

The sensitivity of a measurement system is ultimately limited by the noise level at its input terminals. On the system under discussion, the rms input noise must be less than 0.05 microvolt, preferably less than 0.01 microvolt. The basic problem of design was to attain this low noise level without unduly complicating the operation of the system.

At the 0.01-microvolt level, random noises generated in the input resistor, due to thermal agitation of electrons, and in the first tube of an electronic amplifier, due to shot effect and similar causes, may become significant. The rms value of this type noise voltage is proportional to the square root of the bandwidth of the measurement system and, to be less than 0.01 microvolt, the bandwidth must be less than 10 cycles. This requirement can be met with commercially available equipment.

A source of noise that is more difficult to reduce to acceptable values is pickup from external electromagnetic and electrostatic fields. For example, a 5-gauss (peak), 60-cycle magnetic field can induce in a single turn one centimeter in diameter about 10 microvolts rms. Very complete shielding is necessary to reduce pickup noises to an acceptable value.

Experience has shown that it is extremely difficult to shield adequately an electronic amplifier so that induced voltages, referred to its input, are less than 0.01 micro-

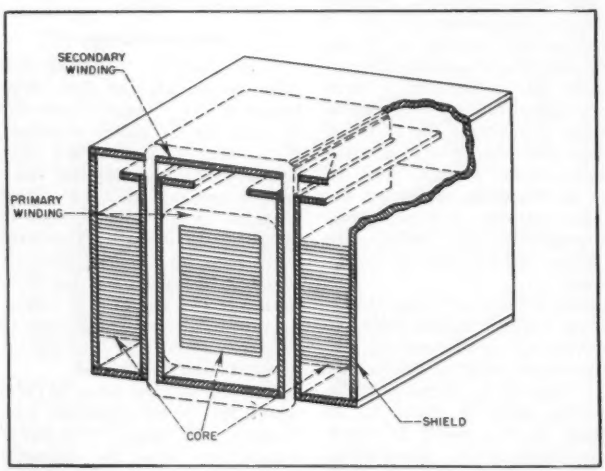


FIG. 1—Cutaway view of the electrostatic shielding used on the high-gain transformer. Transformer matches the 50-ohm input to the grid of the electronic amplifier

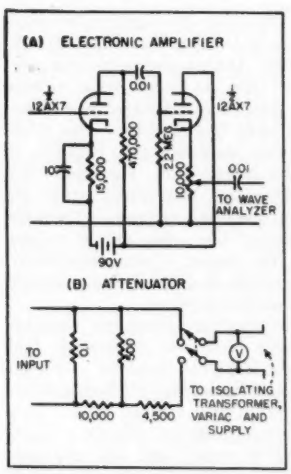


FIG. 2—Schematic diagram of electronic amplifier (A) and attenuator calibrator (B)

Shows Full Scale

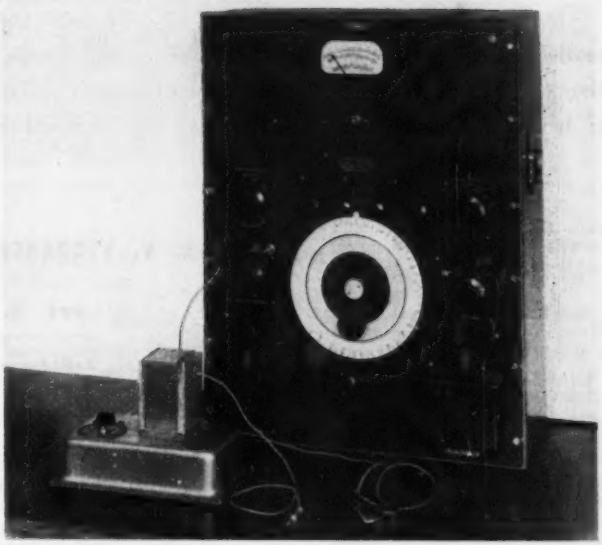
volt when operated under usual laboratory conditions. It is much simpler to shield a small input transformer, designed to match the 50-ohm input to the grid of an electronic amplifier. This approach has the added advantage of providing gain prior to the electronic amplifier, thereby reducing the significance of its inherent noise and induced pickup. By this means, a measurement system has been designed which meets the specifications for sensitivity and precision and which does not require any unusual operating conditions.

Input Transformer

The heart of the system is the input transformer, Fig. 1, which provides a gain of 150, without introducing appreciable noise. The degree to which magnetic and electrostatic shielding is employed in the transformer is important. As shown in Fig. 1, the brass electrostatic shield is arranged to enclose completely the secondary winding and the outside legs of the core, without constituting any short-circuited turns. This shield effectively eliminates any capacitive coupling to the secondary winding. In addition, the transformer is completely enclosed within two concentric mu-metal shields, which provide adequate magnetic shielding.

The circuit of the two-stage electronic amplifier is shown in Fig. 2. The first stage is a voltage amplifier and is followed by a cathode-follower stage to give a low-impedance output. Triodes are used to minimize inherent noise. A maximum voltage gain of about 50 is obtained. The amplifier, including the tube and the plate-supply batteries, is totally enclosed in a shielded chassis.

The output of the amplifier is measured by a General Radio Wave Analyzer, which acts as a narrow-band filter and electronic voltmeter. The gain of the system is normally adjusted to 3,000, which results in a full-scale indication of the wave analyzer, on its 3-millivolt scale, equivalent to one-microvolt input to the system.



System components including input transformer, amplifier and wave analyzer

Calibration Means

A built-in calibration system is provided since no effort was made to design the equipment for long-time stability. The calibrating circuit provides a standard input of 50 microvolts and makes it convenient to calibrate the system frequently for any value of measured circuit impedance within the range of adjustment. The available gain is enough to provide for a measured circuit impedance as high as 50 ohms.

The connecting leads are tightly twisted pairs enclosed in braided shields. All of the system shielding is electrically connected together and is grounded at one point. The leads from the transformer secondary to the input of the electronic amplifier are made very short—about 2 inches. Other connecting leads may be several feet long without introducing pickup trouble.

The noise output, with the input shorted, is less than 0.03 microvolt. The precision of the system is estimated as ± 0.05 microvolt, based on its use in the application for which it was designed. Inputs as high as 50 microvolts can be measured, using the range switch of the wave analyzer as an attenuator. Higher inputs are limited by saturation of the electronic amplifier. The system is sufficiently immune to electrostatic and electromagnetic pickups to permit its use under laboratory conditions with usual precaution. It is important, however, to arrange connections to the measured circuit to minimize undesired pickups.

The combination of a well-shielded transformer and electronic amplifier with the wave analyzer has provided a considerable improvement in measurement sensitivity over usual laboratory technique and has made possible precise a-c measurements in the one-microvolt region.

Ferrite Applications

Small-size high-voltage tv transformer cores and ferrite rod antennas for portable receivers are two outstanding uses of ferromagnetic spinels. Wide application is promising because of high maximum permeability, high electric resistivity and low r-f losses

By B. V. VONDERSCHMITT M. J. OBERT

Tube Department

and H. B. STOTT

Home Instruments Department

Radio Corporation of America
Camden, New Jersey

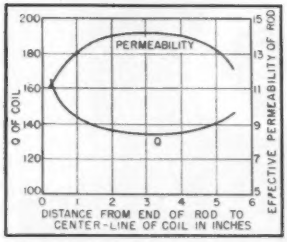


FIG. 1—Variation in Q of coil and permeability of ferrite rod with position of coil on rod

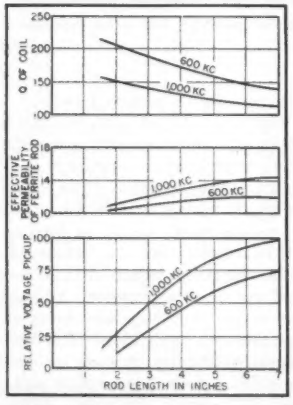


FIG. 2—Variation of Q of coil, permeability of ferrite rod and voltage pickup of antenna with rod length

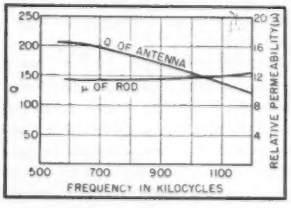


FIG. 3—Variation of Q of antenna and permeability of rod with frequency

RECENT YEARS have seen an increasing use of ferromagnetic spinels, commonly called ferrites, in electronic components to replace silicon-steel laminations, iron wire and powdered iron and to provide components having improved characteristics and reduced bulk.

Characteristics of ferrites such as high maximum permeability, high electric resistivity and low r-f losses, are of particular interest for television components such as yokes and horizontal-deflection output and high-voltage transformers. In such components, the use of ferrites has made an important contribution to increasing operating efficiency and reducing size.

Deflection Transformers

The high power required for deflection in wide-angle kinescopes necessitates the use of efficient deflection systems.

The single item used in the design of a horizontal-deflection output transformer that almost completely determines its efficiency is the magnetic material used for the core. Ferrites have been developed exhibiting characteristics that are very favorable as core material for such transformers. As a result, transformers operating from a moderate power supply with only a single high-voltage rectifier and capable of deflecting kinescopes having a 66-deg horizontal-deflection angle at anode voltages up to 18 kv, have been designed with small C-shaped ferrite cores. The total weight of the ferrite core for such a transformer is approximately 75 grams.

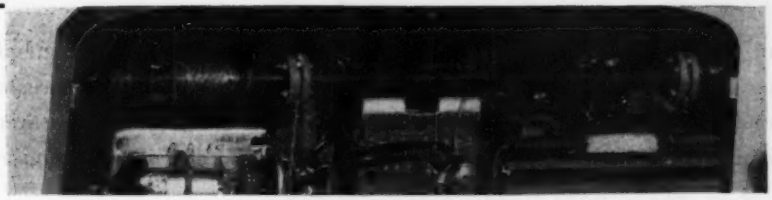
Compact ferrite cores also permit the use of compact coils having high coupling coefficients between primary and secondary windings which reduce the likelihood of Barkhausen oscillations and provide efficient performance.

Ferrites have also made an important contribution in the design and development of deflecting yokes for scanning wide-angle picture tubes. For the flux-return path in these yokes, the ferrites provide a high-permeability low-loss magnetic material which is considerably superior to early powdered-iron cores, and iron core wires.

Ferrite Rod Antenna

Another application in which the use of ferrites has resulted in improved physical and electrical characteristics is in the antenna of small personal radio receivers. Personal receivers in the past have used a flat air-core loop antenna nested within a hinged lid. For satisfactory operation it is necessary to suspend the loop in free space away from the chassis and components so that the loop Q and re-

in Electronic Components



An RCA personal portable receiver showing relative size and location of antenna near top

ceiver performance would not be greatly reduced. The inherent mechanical and breakage troubles have made this type mounting very undesirable.

The new ferrite rod antenna is shock-mounted to the receiver chassis and insulated from it by two soft rubber grommets. The supports holding the grommets have slotted holes to eliminate the shorted-turn effect of metal surrounding the rod.

This complete antenna occupies less than two square inches in area and in a confined space, as compared with the conventional loop antenna of greater than 20 square inches in free space.

For optimum performance, the small coil and the ¼ by 7-in. rod should have the highest possible Q when in its mounted position. The rod must possess low-loss characteristics and high permeability. The pickup ability of the antenna and the signal-to-noise ratio of the receiver are dependent on these two basic criteria, on the resultant tuned-circuit impedance and on certain other design considerations such as the type of wire, winding and form factor of the coil on the ferrite rod.

For a given ferrite rod, there is a particular combination of size, shape and winding pitch factor that, along with the correct ratio of coil diameter to rod diameter, results in maximum pick-up voltage. These factors determine the degree of coupling to the rod and, therefore, the amount of signal flux leakage and self-inductance leakage. Eddy-current losses between adjacent turns and also the distributed capacitance of the winding are reduced by the use of the progressive universal-type winding with 15/43 E.S.S. wire.

Coil Position

The positioning of the coil on the rod is also important. Losses due to ferrous metals close to the rod reduce the Q of the complete assembly; the loss is greatest when the metals are close to the coil winding. Nonferrous metals induce less loss into the antenna but offer some shielding to magnetic pickup. In the RCA receiver, the chassis is constructed of brass, the ganged tuning capacitor has an aluminum frame and the antenna coil is located as far from surrounding components as is compatible with the need for compactness.

The coil is positioned close to one end of the rod for several reasons. First, maximum Q is obtained when the coil is in this position. Second, the effective permeability decreases as the coil approaches the end. This feature is useful in manufacture because it permits adjustment of the antenna to the correct inductance without the necessity for adjusting turns. Fig. 1 shows these effects. The average position is for the center line of the coil to be one inch from the rod end. Adjustment of the coil over the range of ± one-quarter inch represents a change in inductance of about 10 percent.

Another feature due to the smallness of the ferrite antenna is its low distributed capacitance of only two μμf as compared with 14 μμf for conventional loops. With this lower capacitance, it is possible to obtain a higher tuned-circuit impedance because a smaller capacitance range is needed in the ganged-tuning capacitor and a greater value of coil inductance may be used.

The sensitivity of the antenna increases with the number of turns making up the antenna inductance. With the ferrite antenna, the reduced capacitance requirements make possible the use of a compact tuning capacitor having increased plate spacing. The increased spacing reduces capacitor rejects in the factory and minimizes any microphonic tendencies at the higher audio levels.

Ferrite-Rod Dimensions

The length of the ferrite rod has an effect on both the Q of the antenna and the effective permeability. Figure 2 shows variation in Q with incremental increases in the length of the ferrite rod. This variation is due to the greater inherent losses in the longer rods coupled into the antenna coil. Also shown in Fig. 2 are the variations in effective permeability and the relative voltage pickup with rod length. The voltage pickup varies almost directly with rod length and approximately as the square of the rod diameter.

Figure 3 shows the variations with frequency of Q and effective permeability of an antenna having the antenna coil located with its center line one inch from the rod end, the normal operating position. The signal-to-noise ratio of the antenna is improved over that of the conventional loop due to the higher operating Q and the smaller physical size. The smaller size is significant because it reduces the electrostatic pickup.

Television Picture

Analysis of the video waveform in a single scanning line can be made using equipment feeding an oscilloscope and picture monitor. Designed primarily as a research tool, the instrument can also be used by broadcast engineers to simplify the measurement of synchronizing waveforms and aid in evaluating the resolution of television cameras

THE VIDEO WAVEFORM of any selected line, or portion of a line, occurring in a frame interval can be observed on an oscilloscope by use of the instrument to be described.

The usefulness of such an instrument is greatly enhanced if there is freedom from jitter and a simple method of identifying the particular line being observed. This equipment has been designed to satisfy these requirements and provides a reliable yardstick for the evaluation of the performance of television systems and apparatus.

Most oscilloscopes used as video monitors operate with a recurrent sweep which may be set to either 30 cycles or 7.5 kc. When operating under these conditions, the persistence of the oscilloscope phosphor and the persistence of vision stack the video voltages of each scanning line on top of each other. The resulting scope presentation is useful for determining the maximum video excursions in the black and white direction and measuring the ratio of video signal to sync signal occurring in a frame interval; however, it is impossible to analyze the video waveform in a single scanning line with such a presentation.

The television line selector utilizes a triggered sweep with a repetition rate of 30 cycles a second and a variable sweep duration having a minimum value of approximately 2 microseconds and a maximum value of several hundred microseconds. With a presentation of this type, it is possible to observe and measure the video voltage occurring during any single scanning line.

A frame repetition rate rather than a field repetition is used for two reasons. First, it is often desirable to observe the vertical synchronizing signal during the nine-line interval for either of two consecutive fields. As is well known, these signals are different, the even fields having a full line spacing between the last horizontal synchronizing pulse and the start of the equalizing pulses, while the odd fields have a half line spacing. Second, a given scanning line such as the hundredth may contain different information in odd and even fields, especially at the point of horizontal transitions.

Figure 1 shows the comparison between a video scope presentation utilizing a recurrent sweep operating at 15.75 kc and a line-selector sweep operating with a repetition rate of 30 cycles a second and a sweep duration of approximately 70 microseconds.

Equipment

This equipment has been designed to operate in conjunction with a wide-band oscilloscope such as the Tektronix Model 511, which has a triggered sweep and provision for increasing the sweep speed five times and observing any 20-percent section of the horizontal trace. Figure 2 is a block diagram of the line selector.

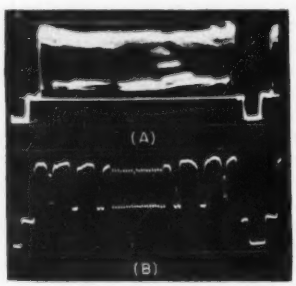


FIG. 1—Conventional scope presentation of recurrent sweep at 15.75 kc at top, and line selector sweep at a repetition rate of 30 cycles

The sync separator removes the video portion of the signal and applies vertical sync to a 30-cycle blocking oscillator which fires on every other integrated vertical sync pulse. The output of the 30-cycle blocking oscillator is a series of narrow pulses having a time separation of 33,333 microseconds (1/30 second). There is only one output pulse for every other field, since the line selector operates at a frame rate rather than a field rate.

The output of the 30-cycle blocking oscillator is used to trigger a cathode-coupled multivibrator (*CCMV* 1). The duration of the pulse produced by this multivibrator may be varied anywhere from 60 to 33,000 microseconds by means of a four-position switch and a vernier potentiometer. The rectangular pulse produced by *CCMV* 1 is differentiated and inverted so the trailing edge becomes a trigger for *CCMV* 2. The pulse duration of this second multivibrator is fixed at 60 microseconds.

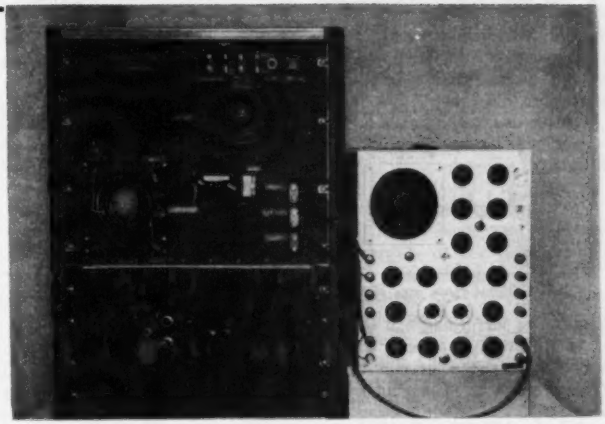
The 60-μsec pulse produced by the second multivibrator serves a double purpose; it is applied to the grid of the crt picture monitor as a horizontal identifying white line, and it is used to open a coincidence gate. Since the 30-cycle blocking oscillator is tied to vertical sync, any adjustment of *CCMV* 1 will cause the identifying horizontal white line to move up and down the picture displayed on the picture monitor.

Laboratory tests have shown that a well-designed cathode-coupled multivibrator being triggered by a stable source and producing a pulse having a duration of

LINE SELECTOR

By JOSEPH FISHER

Project Engineer
Research Division
Philco Corporation
Philadelphia, Pa.



Line selector unit at left, containing built-in picture monitor, operates in conjunction with oscilloscope at right

15,000 microseconds may have a variation of pulse duration of approximately 5 microseconds between consecutive 15,000-microsecond pulses.

If this pulse were used as a trigger, the oscilloscope display would have a 5-microsecond jitter between successive presentations. On a sweep duration of 100 microseconds, this would cause a blurring of the video waveform. If a faster sweep of 15 microseconds were used, the presentation would be definitely unusable because of jitter.

The method used in this equipment to produce a stable jitter-free presentation is to trigger the oscilloscope with a single horizontal sync pulse which precedes the line to be observed. For a line selector operating at frame rate, only one selected horizontal sync pulse is allowed to pass through a coincidence gate every 1/30th of a second. The gate circuit is so arranged that it requires coincidence between the 5-μsec horizontal sync pulse and the 60-μsec identifying pulse for a horizontal sync pulse to pass through. With operation of this type, a small amount of phase jitter is permissible in either the 30-cycle blocking oscillator or the cathode-coupled multivibrators. The phase jitter merely causes a slight relative displacement between the 60-μsec gating pulse and a single horizontal sync pulse and does not affect the stability of the scope presentation.

Selector Circuit

Figure 3 is a circuit diagram of the selector circuit. The 30-cycle blocking oscillator output and the two cathode-coupled multivibrators referred to as *CCMV* 1 and *CCMV* 2 are shown in detail in this dia-

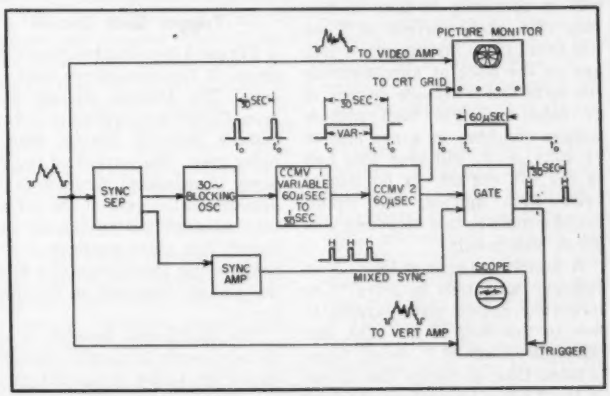


FIG. 2—Arrangement of stages of the line selector and connections to the picture monitor

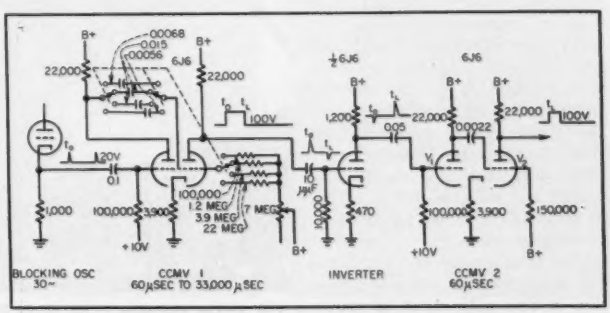


FIG. 3—Two cathode-coupled multivibrators form the selector circuit

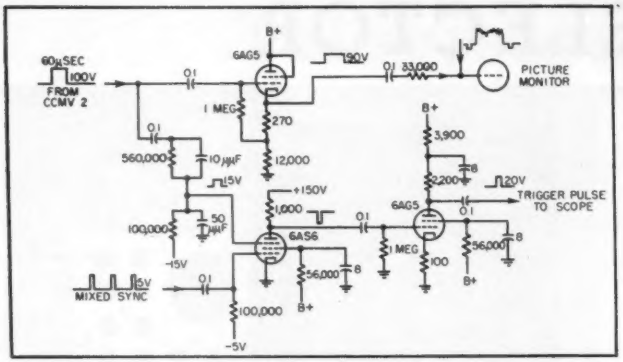


FIG. 4—Coincidence gate circuit feeding the picture tube and the oscilloscope

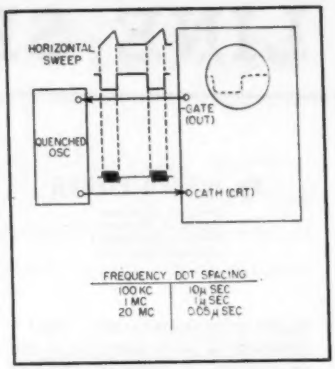


FIG. 5—Block diagram of the marker unit

gram. The performance of *CCMV* 2 is as follows. Consider a time interval before the arrival of the trigger pulse t_1. The grid leak of the right-hand triode section V_2 is connected to +250 volts d-c; the grid-to-cathode resistance will be approximately 1,000 ohms and V_2 will be operating at close to zero bias. The plate current of 7 ma will result in an instantaneous voltage on the plate of approximately 100 volts and a cathode voltage of 27 volts d-c. The high cathode voltage resulting in a net bias of 17 volts on V_1 will keep this half of the 6J6 cut off. If no trigger pulse were applied, the circuit would remain in this operating condition indefinitely.

A positive trigger pulse (t_1) of sufficient amplitude to drive V_1 to zero volts causes plate current to flow in this half of the tube, and the plate voltage of V_1 drops. Since it takes time to change the charge of the 2,200-μμf coupling capacitor, the voltage on the grid of V_2 drops, cuts this section of the tube off, and produces a positive output pulse.

When negative charge on grid of V_2 leaks off through the 150,000-ohm grid leak, V_2 goes into conduction, cutting off V_1. The start of the output pulse is coincident with the trigger applied, while the duration of the pulse depends on the time constant of the coupling capacitor and the grid leak of V_2, and to some extent on the amplitude of the trigger pulse.

The performance of *CCMV* 1 is the same; however, since the duration of this pulse must be continuously variable from 60 microseconds to 33,000 microseconds, a four-position switch is provided to change the RC time constant. After differentiation by the 10-μμf capacitor and the 10,000-ohm grid leak, the trailing pulse t_2 is inverted by the 6J6 triode and applied as a trigger to V_1.

Trigger Gate Circuit

Figure 4 is a detailed circuit diagram of the coincidence gate circuit. The 100-volt 60-μsec pulse from *CCMV* 2 is applied to a 6AG5 cathode follower having close to unity gain. The output of the follower is connected through an RC network to the grid of the crt picture monitor. As previously mentioned, this pulse produces a horizontal white identifying line across the picture displayed on the monitor.

The 33,000-ohm resistor is connected directly to the grid connector on the crt socket to prevent excess capacitance degrading the picture. This resistor and the plate load of the video output tube of the monitor form a resistance divider to attenuate the 90-volt identifying pulse to approximately 10 volts at the crt grid.

The 100-volt 60-μsec pulse from *CCMV* 2 is also fed through a compensated divider to the suppressor grid of the 6AS6 gate tube at a level of 15 volts. Mixed sync which has been separated from the composite video input signal is applied to the control grid. The fixed bias on the suppressor and the control grids are adjusted so that coincidence of the 60-μsec gating pulse, which occurs only once every 1/30th of a second, and a horizontal sync pulse is required to cause plate current to flow. The pulse output voltage of the 6AS6 is then one selected horizontal sync pulse. This pulse is inverted and amplified by the 6AG5 and applied as an ex-

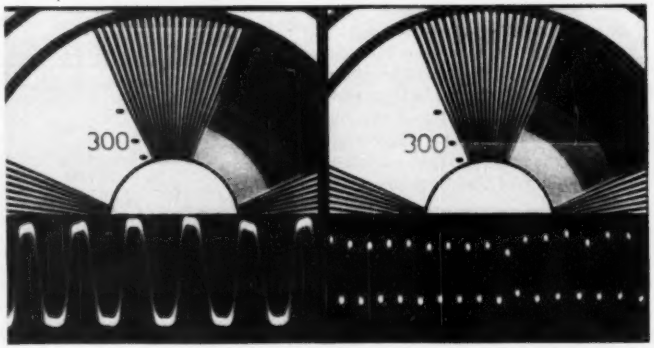


FIG. 7—The illustration at left shows the identifying line at the 100-line mark and the video waveform of this line. Similar data at right is for the 300-line mark

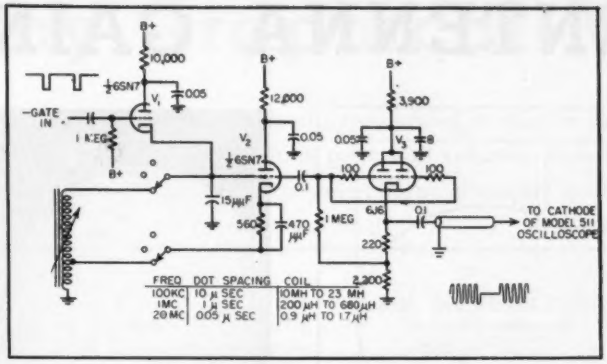


FIG. 6—Circuit for providing time marker data

ternal positive trigger to the oscilloscope.

Intensity Modulation of Trace

Measurements of the time duration of sync pulses and studies of transient responses are greatly simplified by providing time markers which modulate the trace. Figure 5 is a block diagram and Fig. 6 is a circuit diagram of the time marker unit. The performance of this circuit is best understood by omitting tube V_1, and considering V_2 as an ordinary c-w sine wave oscillator. By means of the three-position switch, either of three coils may be inserted in the circuit to produce c-w signals at either 100 kc, 1 mc or 20 mc. This signal is applied to a cathode follower which in turn feeds the cathode of the oscilloscope crt.

If V_1 is inserted and we consider a time interval before the arrival of the negative gate, V_1 is conducting heavily and damping the oscillator tuned circuit with a resistance equal to $1/G_m$ or approximately 400 ohms. This damping prevents V_2 from oscillating. The negative gate pulse from the oscilloscope, which has a time duration equal to the triggered sweep, is applied to V_1 and cuts this tube off. This removes the damping from V_2 and the circuit goes into oscillation for the duration of the sweep. Quenching the oscillator in this manner insures that the time marker dots will remain stationary. Time marker dots spaced at either 10, 1 or 0.05 microseconds are available.

Applications

A very useful application of the line selector is measuring the frequency response and transient response of television cameras and picture-generating devices such as the monoscope and flying spot scanner. Figure 7 shows a study made of the signal generated by a monoscope tube operating into a video amplifier flat to 6 megacycles. The left composite picture shows the identifying line at the 100-line mark, corresponding to a video frequency of 1.25 mc. The video voltage developed when scanning this line is shown under the test chart.

The selector was then adjusted to identify and display the voltage developed when scanning through the 300-line mark, which corresponds to a fundamental frequency of 3.75 mc. The response is down three to one because of aperture distortion (finite size of scanning spot on monoscope). To a first approximation the aperture effect causes only frequency distortion and not phase distortion, and the resolution of the monoscope was improved by adding a circuit having three-to-one peaking between 1 mc and 3.75 mc.

Since most peaking circuits have phase distortion, it was necessary to follow the peaking circuit with a phase corrector which had a flat frequency response and a phase characteristic which was the inverse of the peaking network. The resulting improvement is shown in Fig. 8.

Figure 9 illustrates the results that can be attained with the time marker unit. The top picture shows a horizontal sync pulse time dotted with 1-microsecond markers, while the bottom picture shows a single equalizing pulse intensity modulated with dots having a separation of 0.05 microsecond.

The writer acknowledges the development work done by Eric Bittmann, of Philco Research.

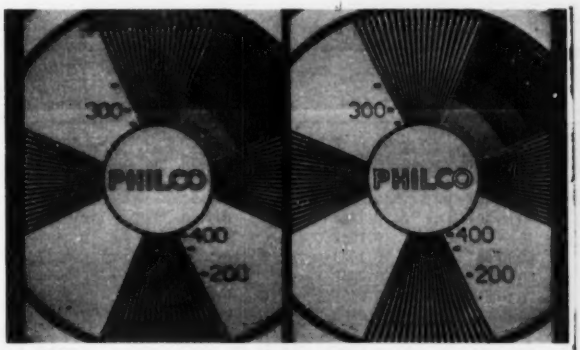


FIG. 8—Test pattern without aperture correction, left, and with aperture correction right

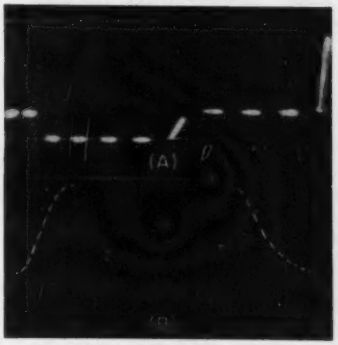


FIG. 9—Horizontal sync pulse with 1μ-sec markers (A), and time dotted equalizing pulse (B)

ANTENNA GAIN

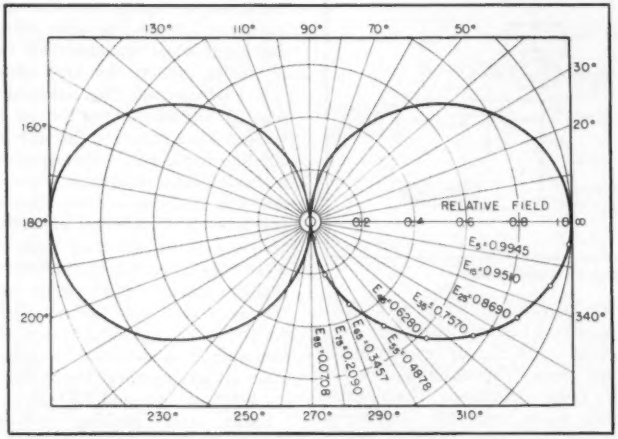


FIG. 1—Radiation from a vertical orientation of a half-wave dipole antenna

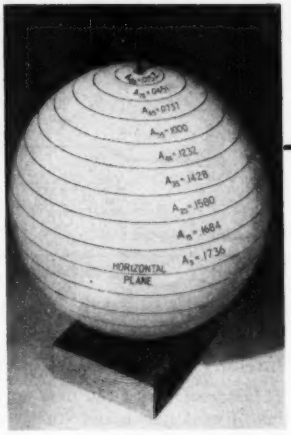


FIG. 2—Sphere marked with area zones

THE calculation of gain from a number of radiation patterns is a widely used technique. The procedure can be reduced to a reasonable limit by a method about to be described. First, it is essential that one understand the manner in which gain depends on radiation patterns.

A simple antenna example, and one for which the results can be readily verified, is the well-known standard half-wave dipole. It is most commonly regarded as a vertical antenna because with this orientation it has equal radiation in all directions in the horizontal plane. In other words, the horizontal pattern is a circle. Because of the simplicity of the dipole structure, vertical patterns are all the same and may be indicated by the curve of Fig. 1. The shape is described precisely by $E = K \cos(\pi/2 \sin \theta)/\cos \theta$, where θ is the angle from the horizontal plane.[1,2]

The reduction of the radiation as the vertical angle increases implies that the total power that is radiated into space for a given field intensity in the horizontal plane is less than would be radiated from the imaginary isotropic radiator (an antenna which radiates equally well in all directions). Conversely, there is available a greater field intensity in the horizontal plane, from this half-wave dipole antenna for a given power input, than is available from an isotropic radiator. This improvement in effectiveness is known as gain and as an IRE standard is specified in terms of power (gain means power gain). Thus the gain of a half-wave dipole antenna is the increase, over an isotropic radiator, in the power received per unit area in the plane of uniform response, when equal input power values are applied.

For this particular antenna, it is desired to find the power radiated into solid space. As indicated previously, this may be determined readily from the patterns of the antenna. Since this antenna has a circular horizontal pattern and all the patterns taken at angles above and below the horizon are circles, one need only be concerned with the manner in which the vertical pattern varies from a circle.

In an integration of the kind about to be performed, the antenna should be imagined as being placed at the center of a large sphere. Such a sphere is shown in the photograph of Fig. 2. The surface of each half has been divided into

Table I—Gain Data for Half-Wave Dipole

Zone, in deg	*Area*	*Power*	*Product*
0 to 10	0.1736	0.9890	0.1718
10 to 20	0.1684	0.9044	0.1523
20 to 30	0.1580	0.7552	0.1194
30 to 40	0.1428	0.5730	0.0818
40 to 50	0.1232	0.3944	0.0486
50 to 60	0.1000	0.2379	0.0238
60 to 70	0.0737	0.1195	0.0088
70 to 80	0.0451	0.0437	0.0020
80 to 90	0.0152	0.0050	0.0001
	1.0000		0.6086

by Graphical Means

Time-consuming computations are avoided in this simple, graphical method of obtaining antenna gain. Once radiation pattern of antenna is known, method is applicable to complex antennas and for determining acoustical gain of loudspeakers and horns

By M. W. SCHELDORF
Director of Research
Andrew Corporation
Chicago, Illinois

nine zones of equal latitude and each zone marked with its relative area using a subscript corresponding to the angle at the center of the zone.

To integrate the energy from the antenna in question, the power falling on each zone is determined (the area times the unit power) and then these powers are added together. The unit power in each zone is found by squaring the field values indicated in Fig. 1. The area of each zone can be found from formulas available in many handbooks, corresponding to the values shown in Fig. 2. Due to symmetry it is necessary to be concerned with only one quadrant. By correlating the curve and data of Fig. 1 with the zones of Fig. 2, the necessary quantities may be set up.

Typical Example

To demonstrate how effective such a simple integration can become, a tabulation of the results for the half-wave dipole antenna, oriented vertically, is shown in Table I.

Notice that if the unit power from an isotropic radiator in each of the zones of the table had been used, the power column would show 1.000 for all zones, the product column would have contained the same numerical values as the area column and the final sum would be 1.0000. Thus, for equal intensities in the horizontal plane, the numbers 1.0000 and 0.6086 correspond to the power radiated. Therefore, the gain of the half-wave dipole antenna is 1.0000 divided by 0.6086 which equals 1.643 or +2.15 db. These values compare favorably with those obtained by more exact completely mathematical means.

It is quite obvious now that to obtain the gain of any antenna having a solid of radiation which is generated by a curve rotated about its vertical axis, it is necessary only to repeat the above simple process. When the upper half and the lower half of the vertical pattern are different, as is often the case in experimental work, the integration must be done for double the number of zones and the gain becomes 2.000 divided by the summation of the products secured.

Some special graph forms have been developed which reduce the integration process to a minimum and permit better accuracy because the incremental zones are reduced to zero width. Refer to the graph paper forms illustrated in Fig. 3, 4 and 5. In effect, power values corresponding to discreet vertical angular positions are plotted linearly as ordinates on each of these papers.

The angular positions are so distributed in the abscissa that they provide the area function, in the products for summation. Thus to find the relative radiated power, from the vertical pattern, the area under a curve plotted on these papers is measured. The area for an isotropic radiator is the area under the horizontal line of ordinate value 1.000. A previous dis-

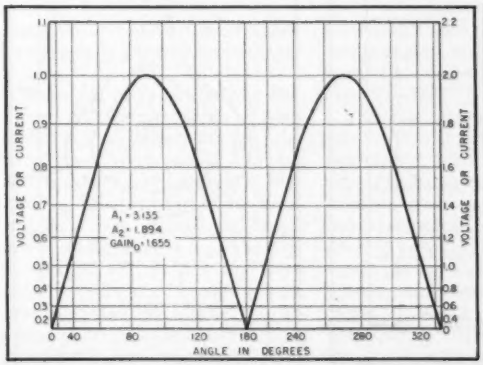


FIG. 3—Gain computation chart for half-wave dipole antenna

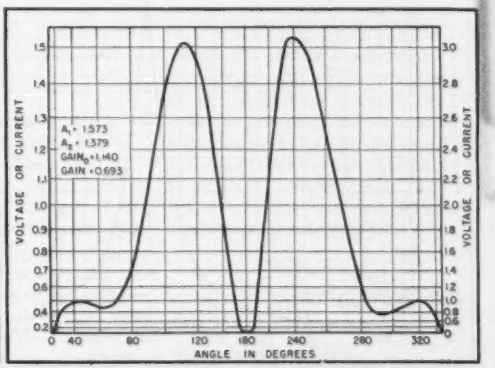


FIG. 4—Gain computation chart for ground-plane antenna

cussion of the general idea for graphical integration is described by Fiet[3].

To obtain the gain of a half-wave dipole antenna, the vertical pattern shown in Fig. 3 was plotted. By means of a polar planimeter, the area under this curve was measured to be 1.894 units and the area for reference as 3.135 units. The power gain is therefore 1.655. The error is less than 1 percent compared with the usual standard of 1.645. Note that in plotting the vertical pattern or beam section on the chart paper, the positions of 90 and 270 deg along the abscissa must be used for the horizontal radiation values of the pattern.

In many cases, especially with experimental data, it is necessary to consider horizontal patterns which are not circular. Also there will be variations in the beam sections. This necessitates the use of more than one integration, one for each beam section.

Suppose first that the horizontal pattern is perfectly circular or near enough so that any deviation may be neglected. Then beam sections equally spaced in the azimuth are used and the gain determined from the average of the individual values of gain. Next, suppose that the horizontal pattern differs considerably from a circle and that the vertical patterns are not alike. Then it is necessary to weigh each vertical pattern in accordance with its importance.

Let curve *A* of Fig. 6 represent the measured horizontal pattern. The magnitude of all the points is increased until the average value corresponds to unity on the scale, as shown in curve *B*. Suppose that there are available vertical patterns for the sections 0 to 180 deg, 45 to 225 deg, 90 to 270 deg and 135 to 315 deg. as shown by the radial lines; then there are two ways of obtaining the gain. One method is to plot each vertical pattern on the special chart paper so that the 90 and 270-deg values agree with the magnitudes on the corrected horizontal pattern B and then take the average of the gain values obtained. A second method is to plot each vertical pattern on the special chart paper so that the 90 and 270-deg values are unity. Then modify each gain value in proportion to the corresponding values on the horizontal pattern B and average.

When making the magnitude corrections with experimental data, it is often necessary to use some arbitrary methods to adjust the values. Many times the horizontal pattern is not in agreement with the corresponding values of power in the vertical patterns. In this case it will be found satisfactory to compare the mean values in the horizontal pattern with the mean values in the vertical pattern and make the adjustment on this basis.

It should be noted also that the gain value obtained by the method described is the average gain in the horizontal plane. The gain in any specific direction is obtained by multiplying the average gain value by the magnitude of the corrected horizontal pattern in that direction.

In many experiments, vertical patterns will be obtained which do not give a maximum power in the horizontal plane. For instance, stub radiators over odd-sized ground planes give a beam which is considerably bent up or down. When such a curve is to be plotted on the special paper such as shown in Fig. 3, the ordinates given on the left-hand margin are not satisfactory.

Since the divisions are not uniform, the scale cannot be readily changed and still keep the curve well up on the paper. A second scale on the right-hand margin has been provided and to permit better proportions for all cases, intermediate scales as shown in Fig. 4 have been provided, one on each margin. In Fig. 4, the kind of off-beam pattern that may be encountered has been plotted. In this case, the area under the curve can easily be more than the area under the curve for a half-wave dipole antenna and hence the gain compared with it is less than unity.

An advantage in the use of the

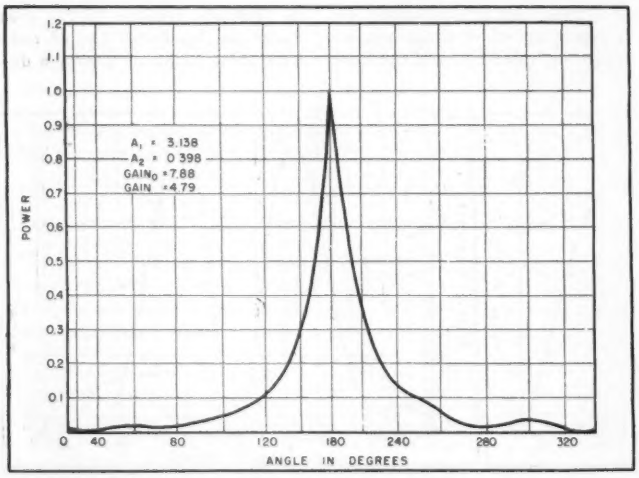


FIG. 5—Gain computation chart for corner-reflector antenna

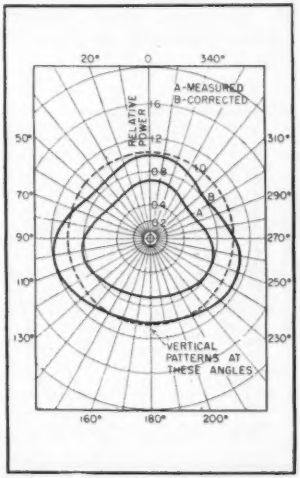


FIG. 6—Horizontal radiation pattern

chart paper becomes obvious at once. The importance of side lobes and unbalanced or off-side beams is made clear by the area that these characteristics contribute to the total area. Conversely, it can be easily observed how unimportant side lobes become when they are present at high elevation angles.

Vertical patterns calculated in terms of power and those measured with square-law detectors may be plotted on chart paper having a uniform distribution of the ordinate values. This is shown in Fig. 5. In this case, it is convenient to use any scale desired, the right-hand margin has been left blank for this purpose.

Gain of Beam Antennas

The discussion up to this point has been restricted to the kind of antennas most commonly used in broadcast services. The solid of radiation approaches a pancake with most of the energy concentrated in a ring in the horizontal plane. There are, in addition, many services that employ beam antennas, in which case the chart paper is used in a slightly different manner.

For simplicity, start with a beam that is uniform in transverse cross-section, that is, the E-plane and H-plane patterns are alike. Assume that the beam is horizontal. Then the spherical surface imagined as surrounding the antenna must be divided into zones as shown in Fig. 7. Note that whereas the high-energy level for the horizontally omnidirectional antenna is projected onto relatively large areas, here the high-energy level is projected onto relatively small areas. The use of the chart becomes clear at once.

Instead of plotting the beam section so that the maximums of radiation occur at 90 and 270 deg, the main beam is plotted at 180 deg and the back radiation at 0 deg. (For a bidirectional beam there will be a peak at both 180 and 0 deg). An example is shown in Fig. 5. It is obvious at once how much more important side lobes become with this type of radiator. It becomes easier to understand why experimental gain values fall below anticipated values with the presence of seemingly insignificant side lobes or back radiation.

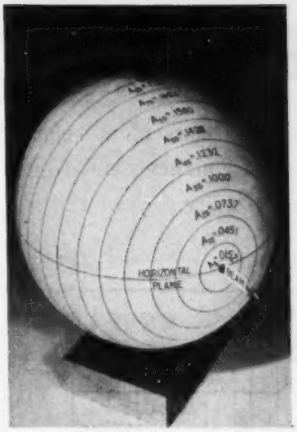


FIG. 7—Sphere for beam antenna

FIG. 8 Sphere for shaped-beam

Shaped Beams

The modern trend toward shaped beams requires a consideration of gain computation suited to them. For a simple regular and minor deviation from a constant cross-section beam, it will suffice to obtain a separate pattern in the E-plane and the H-plane and use the gain obtained from the average value.

When more than two patterns of the beam are required in order to define the shape of the radiation solid sufficiently well, an extension of the above scheme is unsatisfactory, particularly from a polarization standpoint. For both the E-plane and H-plane patterns the polarization may be held fixed but with intermediate patterns, the polarization must vary with the elevation angle. This is both difficult to calculate and difficult to measure experimentally.

The most direct solution is to take additional patterns in the vertical axis of the antenna, at different azimuth angles. The gain is obtained from the average of the individual values, with no consideration to an integration in the horizontal plane. The sections for the patterns are shown in the photograph of Fig. 8. Note that each pattern must be either plotted to its appropriate scale magnitude, without correction, or be plotted to full scale and the integration modified, as done for the noncircular pattern omnidirectional antenna. Note that in this plan for multiple sections, the integration is done along spherical areas known as lunes, such that the effective area of integration to be considered varies the same as for the omnidirectional antenna. The maximum area occurs in the horizontal plane. Hence the antenna power, or field, in the horizontal plane is plotted at 90 and 270 deg on the chart paper. For sharp beams, it is possible to arrange for many sections through the beam and only a few remote from the beam, as long as each integration is weighted in proportion to the width of the section that it represents.

When integrating the patterns of exceptionally sharp beams, it may become necessary to plot the pattern with several scales, in order to obtain the required accuracy. In the extreme case where the number of determinations warrants, it is entirely practical to set up two separate graphical forms, one for the main beam and one for the side lobes, with overlapping angular scales so that these forms will cover a range of beam width.

References

(1) M. W. Scheldorf, A New Studio-To-Transmitter Antenna, *Proc. IRE*, p 103, Feb. 1945.

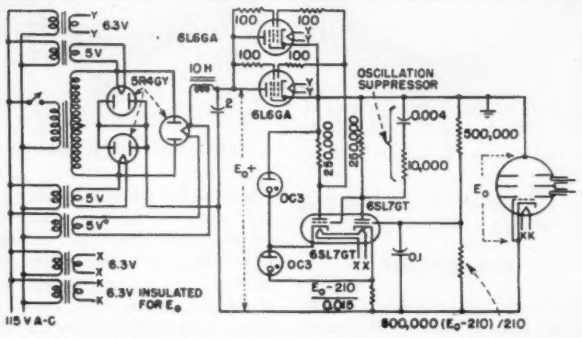
(2) Reference Data for Radio Engineers, Federal Telephone & Radio Corp., First Edition, p 143, 1943.

(3) O. O. Fiet, Measured Characteristics of the Pylon Antenna, *Broadcast News*, p 14, Dec. 1947.

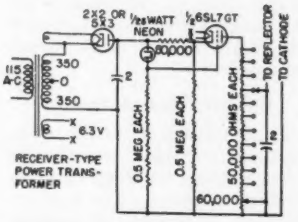
KLYSTRON CIRCUITS

Most-used versions presented for convenient reference, including three regulated power supply circuits, klystron frequency standard, afc for reflex klystron local oscillator, resonant cavity control and phase modulator

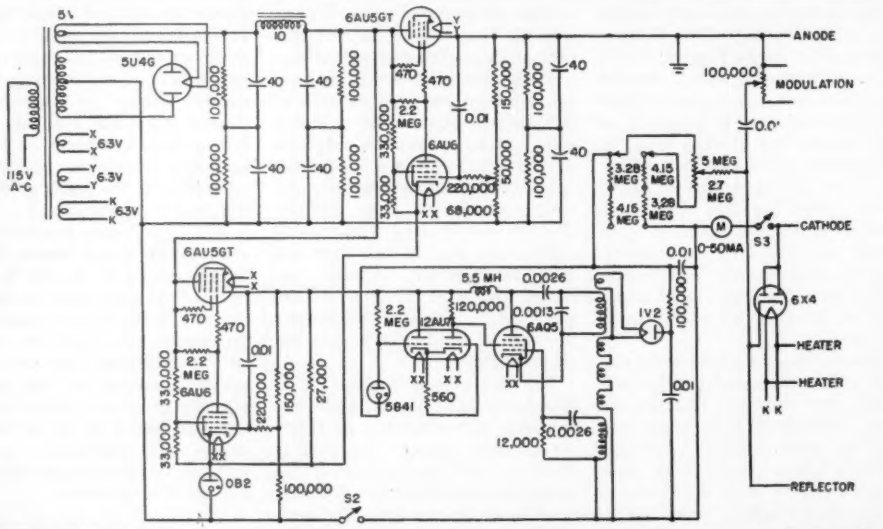
By A. E. HARRISON *Assoc. Prof. of Electrical Engineering, University of Washington, Seattle*



BRIDGE-TYPE POWER SUPPLY—Gives any desired value of beam voltage by changing the two resistors specified in terms of beam voltage E_o, provided input voltage is also changed



HALF-WAVE POWER SUPPLY—Conventional half-wave rectifier is alternative method of obtaining 500 volts for reflector voltage supply. A μ-bridge regulator circuit is particularly applicable because it operates in the negative lead

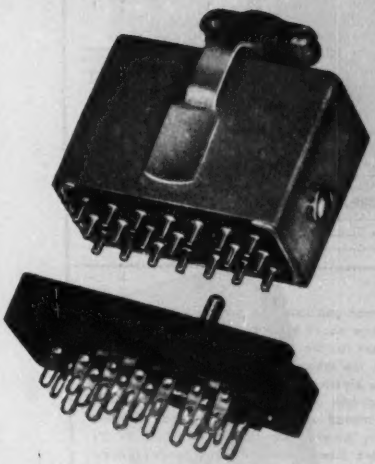


POWER SUPPLY—Simplified version of Hewlett-Packard Model 715-A klystron power supply circuit illustrates design problems for reflex klystrons. Reflector voltage, which requires no power and often operates above ground potential, is supplied by an r-f supply. The r-f oscillator voltage is supplied by an electronically regulated source. An additional feedback circuit from the rectified output voltage improves voltage stability. Reflector voltage is adjustable between 10 and 900 volts. Diode between cathode and reflector leads prevents reflector voltage from becoming positive. Regulated beam voltage is variable from 250 to 400 volts. Single VR tube acts as voltage reference. Switches delay application of beam voltage

(Continued on p 150)

meeting requirements as needed with sound engineering design, volume production, efficient and prompt handling—these form the basis of CINCH service to the electronics industry.

Let CINCH solve your problems



Countless problems have been solved by the large variety of adequate CINCH components. Whatever the requirement for a metal plastic assembly, the record of the past quarter century points to the complete and satisfactory fulfilment when CINCH is called upon.

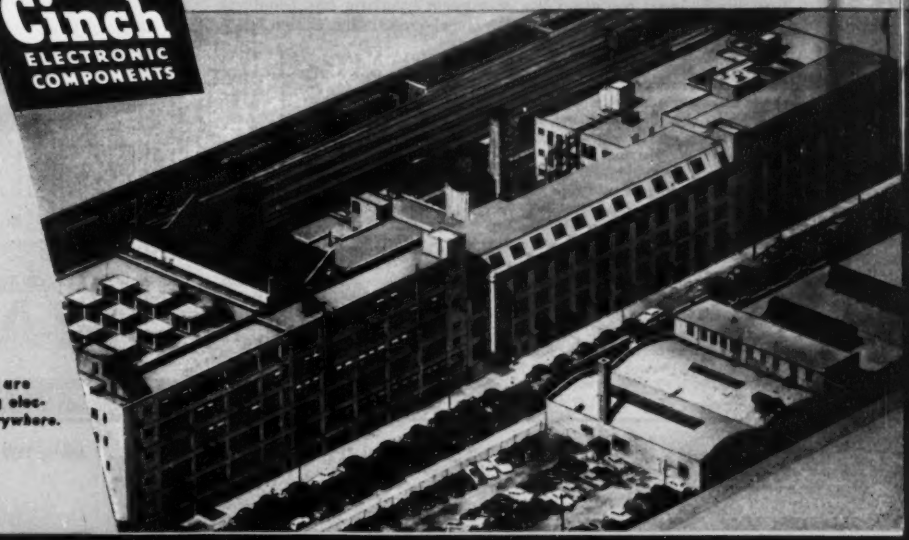
CONSULT CINCH

CINCH MANUFACTURING CORPORATION

1026 South Homan Ave., Chicago 24, Illinois

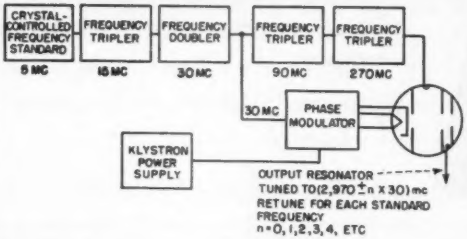
Subsidiary of United-Carr Fastener Corporation, Cambridge, Mass

Cinch
ELECTRONIC
COMPONENTS



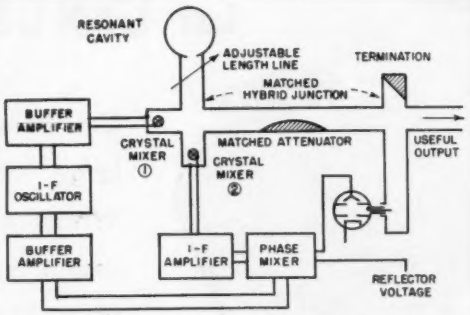
Cinch components are available at leading electronic jobbers—everywhere.

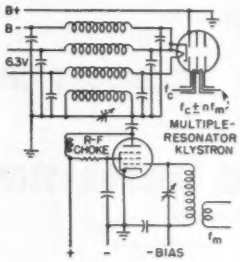
KLYSTRON CIRCUITS (continued from page 148)



FREQUENCY STANDARD—A phase-modulated signal derived from the same source as the input signal for a klystron frequency multiplier can be used to generate standard frequencies in the microwave region. Modulator unit is similar to that shown for phase-modulation of a klystron amplifier. The klystron multiplication factor is 11. The choice of 270-mc input frequency and 30-mc modulation frequency requires only four sidebands to cover the frequency spectrum between harmonics. For example, the next standard frequency above 2,970 + 120 mc is a sideband of the 12th harmonic of the input frequency, or 3,240 — 120 mc

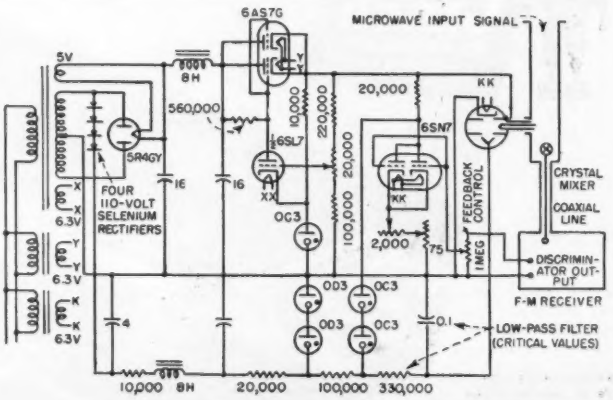
RESONANT CAVITY CONTROL OF REFLEX OSCILLATOR—Frequency stabilization of a reflex klystron oscillator can be obtained by locking the oscillator to a resonant cavity. A block diagram of a method developed by R. V. Pound is illustrated. One hybrid junction (magic tee) provides a sample of the output of the reflex klystron oscillator. When the oscillator frequency coincides with the resonant frequency of the cavity there is no r-f signal at mixer crystal No. 1 and no i-f signal at mixer No. 2. A shift in frequency produces an r-f signal at the first crystal mixer which becomes modulated at the intermediate frequency and reflected to the second mixer where it is demodulated to produce an i-f signal. The phase and amplitude of the demodulated i-f signal are determined by the relation between the klystron frequency and the cavity frequency. The phase mixer compares the demodulated i-f with the original source and produces a signal which corrects the klystron frequency





PHASE MODULATION OF KLYSTRON AMPLIFIER—Some microwave transmitter systems can advantageously use phase modulation, either as a device for modulating a klystron amplifier or as a means of producing two signals with a fixed frequency difference. In most cases the modulation frequency f_m is made high enough so that a sideband can be separated from the carrier frequency f_c by the selectivity of the high-Q output resonator. The problem is to vary the entire electron gun structure, which is at a high d-c voltage above ground, at an r-f rate. Since r-f chokes for the heater leads are not too practical, the scheme illustrated for including the three klystron leads as part of the plate tank circuit has been devised. The klystron leads are wound with the same number of turns as an integral part of the tank coil but insulated adequately for the cathode voltage on the klystron. The r-f circuit must be kept close to the klystron socket

AFC—Reflex klystron oscillators are ideally suited to automatic frequency control in f-m systems because the d-c output of the discriminator can be applied to the reflector electrode to control the frequency of the local oscillator. The reflector voltage supply in this circuit is obtained from a selenium rectifier so that a common grounded lead can be connected to the cathode of a type 723 A/B or similar reflex klystron local oscillator. Two VR-tube regulators in series give adequate voltage stability for this application. The output of the f-m discriminator is connected to the grid of a d-c amplifier which controls the reflector voltage. The 2,000-ohm and 75-ohm variable resistors in the cathode lead act as rough and fine controls of the average reflector voltage



Are you headed for trouble with your vibrator power supply units?

Specification of vibrator frequency, voltage and size is no guarantee that your power supply unit will do its job right . . . permit your mobile radio equipment to operate properly.

To get long, trouble-free performance, the power circuit must be designed so that the characteristics of the vibrator are in balance with the transformer and buffer capacitor.

That kind of designing is a job for experts . . . engineers with specialized knowledge, skill and experience.

Experienced manufacturers of mobile communications equipment turn to Mallory because they know Mallory has facilities, knowledge and engineering skills that are available nowhere else.

Mallory pioneered practical vibrator development . . . produced the first commercial vibrator more than 20 years ago. Since that time, Mallory has developed and produced many new and improved types of vibrators for both civilian and military use.

Today Mallory is recognized as the leader in the field and more Mallory vibrators are used as original equipment in mobile radios than all other makes combined.

You'll save yourself time, trouble and expense in connection with vibrator power supply units by calling on Mallory while your plans are in the design stage. Write or telephone Mallory today.

*Reg. U. S. Pat. Off.

Vibrators and Vibrapack* Power Supplies

P.R. MALLORY & CO. Inc.

MALLORY

SERVING INDUSTRY WITH

Electromechanical Products—Resistors • Switches • TV Tuners • Vibrators
Electrochemical Products—Capacitors • Rectifiers • Mercury Dry Batteries
Metallurgical Products—Contacts • Special Metals • Welding Materials

P. R. MALLORY & CO., INC., INDIANAPOLIS 6, INDIANA

ELECTRONS AT WORK

Including INDUSTRIAL CONTROL

Edited by RONALD K. JURGEN

Facsimile-Scanner Function Generator..152
Electronic Fly-Ash Recorder.....154
The Front Cover.....156
Television Pattern Generator.....158
High-Speed Recorder.....162
Economical Selective Calling Circuits..174
Voltage Regulator for Telescribers.....194
Accurate Phase by Lissajous Figures..206
Small-Station Program Recording.....222
Automatic Morse-Code Typer.....230
Video-Detector Sound Amplifier.....238
Photoelectric Dew-Point Hygrometer....242

Facsimile-Scanner Function Generator

By JAMES C. BARNES
Assistant Professor
Electrical Engineering Department
University of Minnesota
Minneapolis, Minnesota

IN THE SOLUTION of certain problems by electrical analog methods it may be necessary to employ a relation between two variables which is specified graphically. In others, although an analytical expression is available, the analytical relation may require rather elaborate arrangements to provide an electrical analog. Hence a convenient means of obtaining an electrical representation of a graphed function is of value.

To allow using a graph rather than a profile (as used by Sunstein, ELECTRONICS, p 100, Feb. 1949), the possible use of facsimile techniques was investigated, since graphs are suitable subject copy for transmission by facsimile systems. If a graph is scanned with the scanning lines parallel to the vertical axis, there is a pulse in the scanner output each time the scanning spot passes over the curve. The result is a pulse-time-modulated signal, the timing of the pulses representing the height, or ordinate, of the curve.

To demonstrate the proposed method, a drum-type facsimile scanner was adapted to generate an electrical signal from a graphed function. In the particular scanner used, the drum on which the copy is scanned is 6 in. in circumference and 4½ in. long. The drum is rotated at 300 rpm by a synchronous motor, so that the graph is scanned at a rate of five lines per second. The exact speed is not important, but it is essential for the speed to be constant. By means of an optical system, light reflected from a small area of the graph sheet is directed to a phototube. The optical system is stationary and the drum, as it rotates, feeds axially past the optical system at the rate of 1/200th in. per drum revolution.

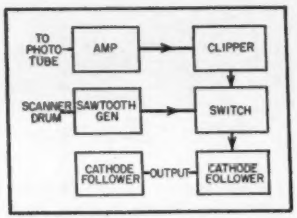


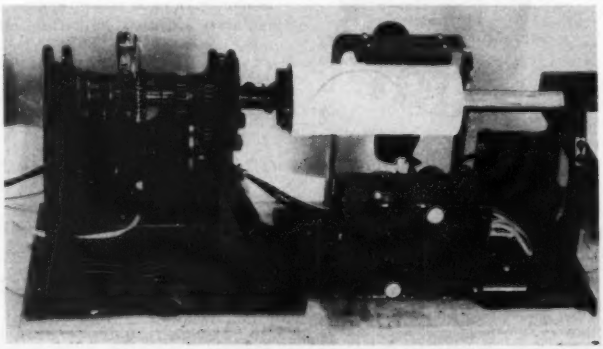
FIG. 1—Block diagram of the function generator

The time required to complete the scanning is 160 seconds. This is inconveniently long but has no adverse effect on the results with an analog computer of the Reac type. A higher scanning speed and wider line spacing would be desirable to reduce this time. Also, a larger drum would be preferable since errors in drawing on larger paper would be less important in percentage. However, facsimile equipment having these desirable features was not available for the tests.

Figure 1 is a block diagram of the circuit employed, and Figure 2 shows the waveforms at various points as indicated. For purposes of illustration, the variations in the pulse spacing are exaggerated on Fig. 2.

Referring to the figures, the cam-operated contact triggers a sawtooth generator each revolution of the drum. The output of the sawtooth generator is fed through a cathode follower to an electronic switch, so that the input to the switch is a sawtooth voltage at low impedance.

The switch, normally nonconducting, is actuated by amplified pulses from the phototube output so that it conducts momentarily when the curve passes the scanning spot. When the switch is thus caused to conduct, it charges a capacitor to the voltage of the sawtooth input at that instant, the time constant of the charging circuit being short. This capacitor then remains



View of the experimental model of the function generator

TEST

ANALYZE

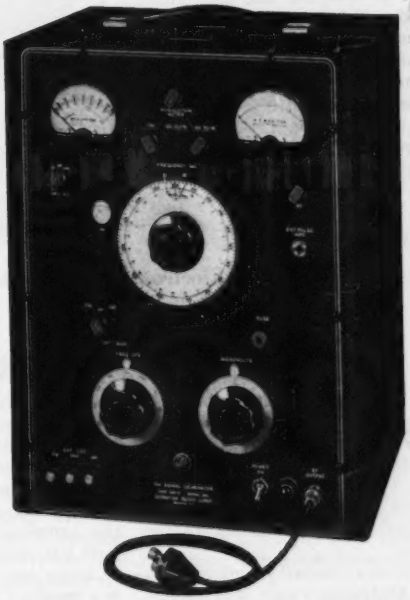
EVALUATE

Telemetering Performance Quickly and Accurately

SIGNAL GENERATOR

Type 202-D

Frequency Range 175-250 mc.



With the type 202-D Signal Generator, you can quickly and accurately test, analyze and evaluate the performance of telemetering receivers and associated equipment. Note that the frequency coverage of the instrument is provided in a single range between 175-250 mc.

SPECIFICATIONS:

RF RANGE: 175-250 megacycles in one range, accurate to ± 0.5%. Main frequency dial also calibrated in 24 equal divisions for use with vernier frequency dial.

VERNIER FREQUENCY DIAL: This dial is divided into approximately 100 equal scale divisions and is coupled to the main frequency dial by a 24:1 gear train. The approximate frequency change per vernier division is 35 kc.

FREQUENCY MODULATION (DEVIATION): The FM deviation is continuously variable from zero to 240 kc. The modulation meter is calibrated in three FM ranges (1) 0-24 kc., (2) 0-80 kc., and (3) 0-240 kc. deviation.

AMPLITUDE MODULATION: Utilizing the internal audio oscillator amplitude modulation may be obtained over the range of 0-50% with meter calibration points of 30% and 50%. By means of an external audio oscillator the RF carrier may be amplitude modulated to substantially 100%. A front panel jack is provided which permits direct connection of an external modulating voltage source to the final stage for pulse and square wave modulation. Under these conditions the rise time of the modulated carrier is less than 0.25 microseconds and the decay time less than 0.8 microseconds.

MODULATION CONTROLS: Separate potentiometers are provided for continuous control of FM and AM levels.

MODULATING OSCILLATOR: The internal AF oscillator may be switched to provide either frequency or amplitude modulation. It may also be switched off. Eight fixed frequencies between 50 cycles and 15 kilocycles are available, any one of which may be selected by a rotary type switch.

RF OUTPUT VOLTAGE: The RF output voltage is continuously variable over a range from 0.1 microvolt to 0.2 volts at the terminals of the output cable. The impedance of the RF output jack, looking into the instrument, is 53 ohms resistive.

DISTORTION: FM: The overall FM distortion at 75 kc. is less than 2% and at 240 kc. less than 10%.

AM: The distortion present at the RF output for 30% amplitude modulation is less than 3% and for 50% AM less than 6.5. At 100% the distortion is 12% to 15% depending upon the modulating frequency.

SPURIOUS RF OUTPUT: All spurious RF output voltages are at least 25 db. below the desired fundamental. Total RMS spurious FM from the 60 cycles power source is down more than 50 db., with 75 kc. deviation as a reference level.

EXTERNAL MODULATION REQUIREMENTS:

Frequency Modulation: The deviation sensitivity is 50 kc. per volt. For external FM the input impedance is 1500 ohms.

Amplitude Modulation: Approximately 45 volts are required for 50% modulation and 100 volts for 100% modulation. For external AM the input impedance is 7500 ohms.

Audio Voltage for External Use: There is available at the FM external oscillator binding posts about 5 volts a.c. maximum and at the AM external oscillator binding posts, 50 volts maximum.

DIMENSIONS AND WEIGHT: Outside cabinet dimensions: 17" high, 13½" wide, 11½" deep. Weight: 35 pounds.

Price: $980.00 F.O.B. Boonton, N. J.

BOONTON RADIO
BOONTON·N·J·U·S·A· *Corporation*

Visit our booth 276-277 at the I.R.E. Show

charged at this voltage, except for leakage, until the next switch operation when the curve passes the scanning spot again. Accordingly, if a linear sawtooth is assumed, the voltage on the capacitor is proportional to the time between the start of the sawtooth and the occurrence of the pulse, except for an additive constant. This, in turn, is proportional to the height of the curve, again with an additive constant.

It is essential that only pulses produced by scanning the curve actuate the switch. However, the phototube output contains fluctuations due to cross-section lines and paper irregularities in addition to the useful pulses. The amplitude of these fluctuations is relatively small, provided that the cross-section lines are light. Cross-section paper having light green cross-section lines met this requirement.

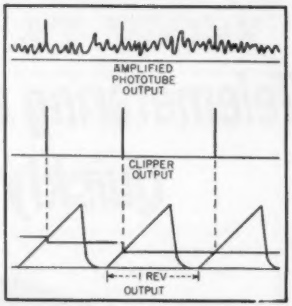


FIG. 2—Exaggerated view of the variations in pulse spacing

The amplified output of the phototube is clipped to remove the unwanted fluctuations, leaving the pulses as required.

The capacitor charged by the electronic switch is connected to a cathode follower. The output is taken between the cathode of this tube and the cathode of another cathode follower whose grid voltage is adjustable. This adjustment permits setting for zero output when the zero reference mark is scanned. A second adjustment controls the period of the sawtooth generator. This effectively is a control on the vertical scale factor, or signal volts per unit distance on the vertical scale of the graph. It is set when the reference mark at the scale maximum is scanned.

Industrial Electronic Fly-Ash Recorder

MARCEL GROBTUCH
Melbourne, Australia

AN ELECTRONIC fly-ash recorder to be used for examination of dust output from boilers has been designed and constructed in Australia. Performance and usefulness exceed that of any other piece of similar equipment known to the writer.

The idea was first examined when the Australian Paper Manufacturers Ltd. found it necessary to meter the relatively large particles of dust as apart from the smoke in the flue gases issuing from the stack of one of its several mills. The stack in question is common to three boilers, each being metered independently and recorded on a multipoint strip-chart recorder.

A six-in. diameter sampling tube was fitted across the induced draft fan and inspection ports of 1¼-in. inside diameter tubing mounted on the sampling tube. These ports were left open to enable the air to be drawn continuously into the tube as a result of the negative pressure inside. An attempt to use windows was made in the early stages of experiments but invariably they became fogged after only a short period of operation and efforts to create drafts across the surfaces of the glasses were unsuccessful.

A phototube is situated on one side of the inspection port with a low-voltage d-c light source opposite. A slit of light is focused at the center of the sampling tube and passes through to the phototube. A pulsating direct current flows in the cathode resistor of the tube. The frequency of the a-c component depends upon the number of shadows per second affecting the cell due to the light absorbed by the dust particles.

The a-c component is amplified through a three-stage amplifier and applied to a direct-reading frequency meter. The current through the 6H6, Fig. 1, is directly proportional to the frequency at which the dust particles pass the inspection point.

The movement of a chopper-bar-type of multipoint recorder is in

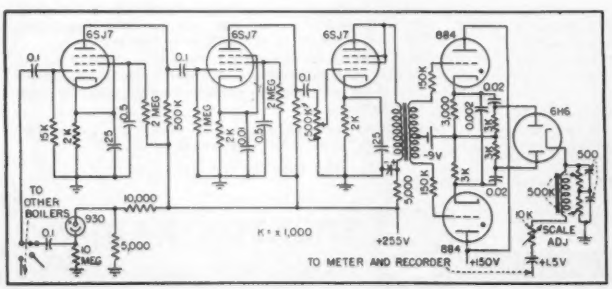


FIG. 1—Fly-ash recorder circuit diagram

Installation of the recorder on a pipe

C-D-F makes all three!

low cost Spiral Tubing

● Designers, engineers, production men everywhere are changing their thinking (and specifications) over to economical C-D-F spiral tubing. Whether it's round, square, or rectangular, C-D-F tubing is stiff, sturdy, crush resistant. It has good tensile strength, along with good dimensional stability under varying atmospheric conditions.

Above all, it is low in cost. C-D-F experts in insulation, recommend spiral tubing for coils and structural spacers. For transformers, switches, selenium rectifiers.

The round tubing ranges from ⅛" to 6", with wall thicknesses from .0075" to ⅛". The minimum ID of the square and rectangular tubing is ⅜", with 2⅛" the maximum ID. 1/16" is the maximum wall thickness. All tubing can be supplied in lengths from 2' to 4'. From our own fabricating experience, we know you will find this sturdy material easy to drill, tap, rivet, flute or thread.

Think it over . . . then talk to the man from C-D-F, a skilled plastics engineer, C-D-F has sales offices in principal cities with modern test laboratories at all plants. C-D-F spiral tubing. The man from C-D-F. *Both* are good to know!

FOR LITTLE COILS . . .

● C-D-F puts notches in to make winding easy. Hard to crush, this tube withstands prolonged heat of 190°F., 240°F. intermittently. Write for samples and complete specifications. For availability, economy, adaptability . . . buy your spiral tubing from C-D-F.

CDF

Continental-Diamond Fibre Company

General Offices **NEWARK 16, DELAWARE**

THE FRONT COVER

A SYSTEM of high-powered vhf and uhf radio transmitters has been installed by National Bureau of Standards engineers G. R. Chambers and J. H. Chisholm on Cheyenne Mountain, Colorado, for radio-propagation research. The transmitters are crystal controlled and radiate unmodulated signals. Two vhf transmitters, generating 3 kw at 100 and 200 mc, feed antennas on the tower together with a 4-kw uhf transmitter operating at 1,047 mc. Two other vhf transmitters operate at a level 1,500 ft lower.

Preliminary measurements of radio fields at distances 100 to 300 miles beyond the 82-mile radio horizon have indicated considerably stronger fields than those prescribed by standard diffraction theory. A new theory has been evolved for the propagation of vhf radio waves beyond the horizon by Dr. J. Feinstein of the NBS staff.

series with the microammeter in the diode cathode circuit. As the rate of fluctuation is extremely high, it was found necessary to introduce a long time constant in the 6H6 cathode so as to record only an average.

The purpose of the recorder is not to measure the absolute number of particles above a certain size. It is intended to indicate trends in the quantity of ash passing into the atmosphere. The minimum size of particle counted is easily governed by the setting of the gain control. The instrument, however, is not affected by a relatively constant background of the smoke comprising much smaller particles.

The instrument has an added advantage in its ability not to ignore slow ambient light-intensity changes. The reading is not affected by the slight fogging of the phototube by dust or by small changes in light intensity due to the fact that the frequency meter used is insensitive to changes in amplitude of the applied waveform.

The input to the amplifier is successively switched to the three boilers by a selector switch in the recorder so that any individual offending boiler may be easily discovered and the cause rectified.

Television Pattern Generator

CIRCUIT TECHNIQUES like those in a tv transmitter sync generator are utilized in the Hickok Videometer, a pattern generator for receiver testing. The instrument contains a crystal-controlled oscillator at 315 kc, from which accurately timed signals are divided down to 15,750, 900 and 60 cycles.

Combinations of these frequencies provide a choice of video outputs for a dot pattern, a crosshatch pattern, horizontal lines plus framing frequency, vertical lines plus framing frequency, and framing frequency with blank raster. The video output can also be used to modulate low or high-band oscillators in the unit. The bar-dot pattern consists of 15 horizontal bars (14 normally visible), 20 vertical bars, or 300 dots.

The crystal-controlled frequency of 315 kc is divided down by relaxation oscillators. Four shaping circuits are employed. The various frequencies taken from the timer are shaped and fed to the mixers in proper polarity and amplitude.

The output of the mixers is fed into a plate-cathode phase inverter providing outputs of either positive or negative polarity. These are fed to the amplifier and cathode follower, and are available at the video output and are also used to modulate the r-f channel oscillators.

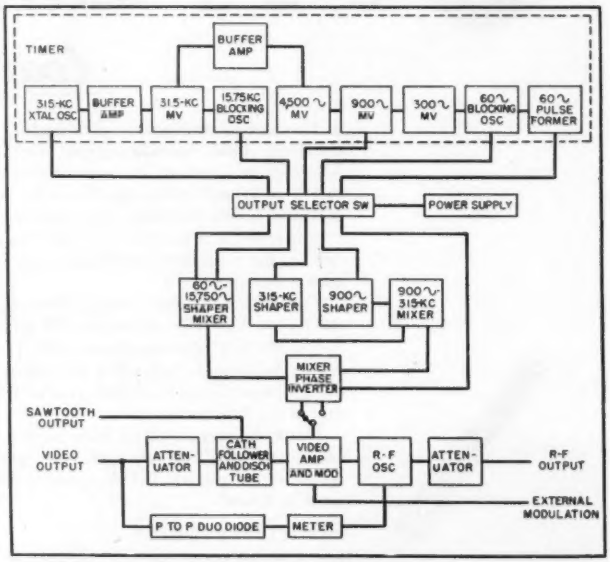


FIG. 1—Arrangement of stages of the Hickok Videometer, a bar and dot pattern generator

Output of the phase inverter is connected to a video amplifier and amplified without appreciable loss to the higher frequency components. The video amplifier is also utilized

Help to Engineers

who are concerned with the future of their careers

ARE YOU IN A "DEAD END" JOB with no chance to move forward?

Would you like work that challenges your creative thinking and skills?

Is your present position limiting your opportunity for the complete expression of your talents in electronics?

Do you and your family worry about your career, or where you live now, or about security and your future?

If the answer is "yes" to one or more of these questions—then you should send for a *free* copy of RCA's new booklet CHALLENGE AND OPPORTUNITY, *The Role of the Engineer in RCA.*

This 36-page, illustrated booklet, just off the press, will show you the splendid opportunities offered by RCA to put your career on the upswing. See how, as part of the RCA team, daily contact with the best minds in various fields of electronics, and with world-renowned specialists will stimulate your creative thinking.

For graduate engineers who can see the challenge of the future, RCA offers opportunities for achievement and advancement that are legion. Send for a copy of CHALLENGE AND OPPORTUNITY, *The Role of the Engineer in RCA.* It is yours *free* for the asking.

Awards . . . Special Recognition
Retirement Plan . . . Insurance
Protection Program
RCA Engineering Activities and Policies
How RCA Serves the Government, Science and Industry
Pleasant Communities in Which to Live and Work
Facilities to Support Fully Every Requirement
Opportunities for Progressive Growth and Advancement
RCA Tubes . . . Pace Setters for Our Electronized Civilization

To Qualified Engineers:

If you qualify for any of the positions listed below, write us for a personal interview—include a complete résumé of your education and experience. Write to address in coupon.

RCA **RADIO CORPORATION of AMERICA**

POSITIONS OPEN IN THE FOLLOWING FIELDS:

- ***Television Development***
- ***Electron Tube Development***
- ***Transformer and Coil Design***
- ***Communications***
- ***Radar—Missile Guidance***
- ***Computer Development and Design***
- ***Navigational Aids***
- ***Technical Sales***
- ***Electronic Equipment Field Service***

MAIL COUPON NOW!

MR. ROBERT E. McQUISTON, Manager
Specialized Employment Division, Dept. 46C.
Radio Corporation of America
30 Rockefeller Plaza, New York 20, N. Y.

Without obligation on my part, please send me a free copy of CHALLENGE AND OPPORTUNITY.

Name_____

Address_____

City_____ State_____

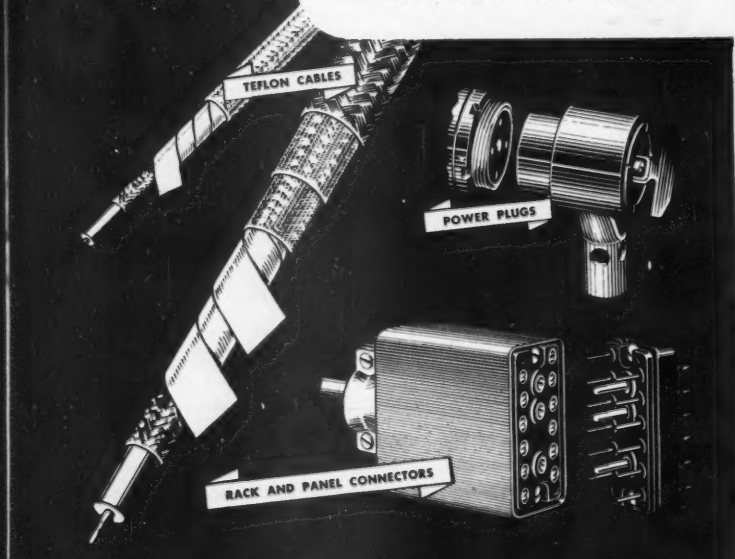
List degree or degrees_____

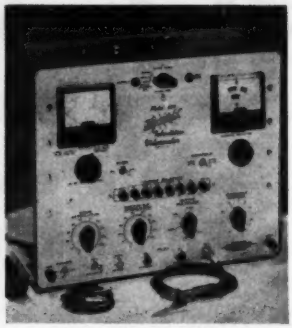
Specify
AMPHENOL
FOR QUALITY

It has taken years of constant research and development to make Amphenol the keyword in the electronics industry. Specifying Amphenol is specifying quality! From the inclusion of only the best of top-grade materials to the last rigid inspection of the finished component, nothing is overlooked in making *every* Amphenol connector or cable the best in quality that can be produced.

A copy of Amphenol's B-2 General Catalog will be sent on request.

AMERICAN PHENOLIC CORPORATION
1830 SO. 54TH AVENUE • CHICAGO 50, ILLINOIS





The television pattern generator

as a modulator for the r-f channel oscillators.

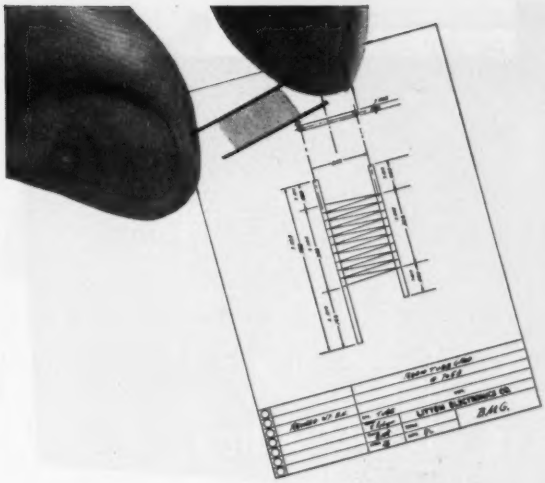
One duo-triode tube, tied in parallel, is utilized as both cathode follower and discharge tube. With the waveform selector in the video output ON position, the plate is heavily bypassed and the tube operates as a cathode follower with the output taken from the cathode. With the waveform selector set to either 60 or 15,750-cycle sawtooth output, the cathode is grounded and a resistor and discharge capacitor are switched into the plate circuit. The sawtooth output is formed and taken from the plate and the tube acts as a discharge tube.

R-F Output

Two independent Colpitts oscillators are employed, one for the low channels and one for the high channels. These oscillators are plate-modulated through an RC and L network from the plate of the modulator. Both oscillators are continuously tuned and calibrated in channel numbers. The percentage of modulation is variable.

Video output is taken directly from the video attenuator of the cathode follower and fed into a peak-to-peak duo-diode. Direct current from this rectifier is fed into a meter which is calibrated in peak-to-peak volts.

With the instrument, problems involving isolation or nonlinearity in sweep circuits, phase distortion, hum, frequency response and adjustment of hold controls can be solved. In this connection, it is interesting to note that since the television test pattern does not



Tight "specs" on small, fragile parts

are quickly and completely checked on a KODAK CONTOUR PROJECTOR

Whether you're checking this tiny radio tube grid or a big, intricate commutator a foot in diameter, a Kodak Contour Projector keeps on paying its way in your inspection department.

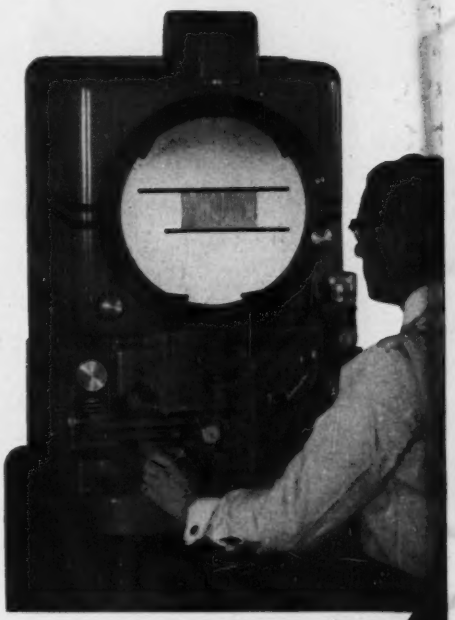
The new Model 2A is seen here being used to measure spot samples of parts far too delicate for any but the optical method of gaging.

Newly designed vertical and horizontal measuring attachments let you apply precision micrometry to otherwise inaccessible dimensions that would be distorted by mechanical contact.

Moments later, you might want even more precise measurements on a bulky part that needs the full eight inches of clearance between lens and object plane. With the Kodak Contour Projector, you get this large working space for any of six magnifications you can dial.

If you need optical gaging for rapid routine inspection rather than for measurements, the stripped-down Model 3 is your choice. A fixture designed for maximum efficiency in handling your particular part goes on the stage. Over the screen goes a chart-gage keyed to the fixture and carrying all tolerances. Even an inexperienced operator can either pass a part or see at once which of many dimensions are off and by how much. To inspect an entirely different kind of part means only slipping in a different fixture with its corresponding chart-gage.

In your area there's an engineer with wide experience in both aspects of optical gaging technique. It will cost you nothing to discuss with him the details pertinent to your own particular requirements. To get in touch with him, write Eastman Kodak Company, Industrial Optical Sales Division, Rochester 4, N. Y.

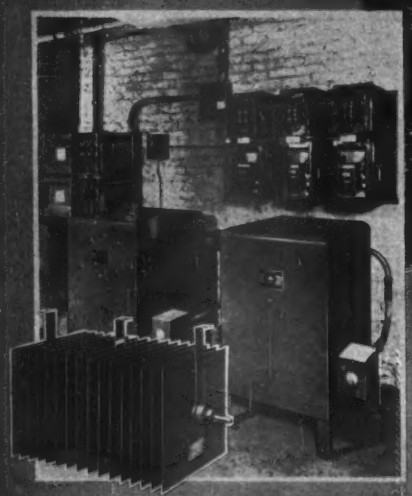


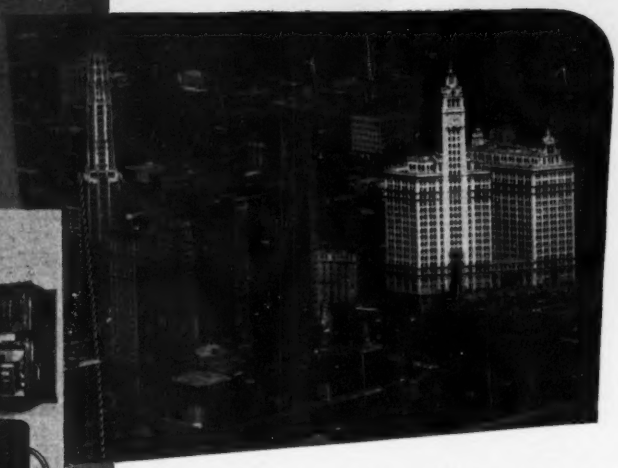
the KODAK CONTOUR PROJECTOR

If you want to check precision spur and helical gears in action, write for information about Kodak Conju-Gage Instrumentation.

Kodak

HOW SELETRON RECTIFIERS GAVE CHICAGO A LIFT





PARTIAL LIST OF ELEVATOR INSTALLATIONS USING SELETRON RECTIFIERS IN THE CHICAGO AREA

BUILDING	NO. OF RECTIFIERS	APPROX. NO. OF ELEVATORS
Drake Hotel Towers, 179 E. Lake Shore Dr.	4 ea. 35 KW	6
Garden City Plating, 1750 N. Ashland Ave.	2 ea. 40 KW	3
Jewish Charities, 241 S. Wells	2 ea. 20 KW	3
1366 North Dearborn Building	3 ea. 27½ KW	4
40 E. Scott Street Building	2 ea. 14 KW	2
Bernstein Building, 14 S. Clinton	2 ea. 10 KW	2
Bush Temple, 800 North Clark	2 ea. 20 KW	3
Clinton Realty, 5228 Clinton	2 ea. 20 KW 1 ea. 14 KW 1 ea. 15 KW	4
Chasing Hotel, 1036 N. Dearborn	2 ea. 20 KW	2
Mera Hotel, 1558 N. Clark	3 ea. 10 KW	3
Sears & Roebuck Co., 312 N. May	3 ea. 25 KW	2
Covenant Club, 10 North Dearborn	2 ea. 20 KW	3
Hopkins Apts., 1201 North State	2 ea. 17 KW	2
Insulare Elec. Bldg., 1708 S. Wabash	2 ea. 10 KW	2
30 East Cedar	2 ea. 14 KW	3
Michael Reese Hospital	4 ea. 50 KW	10
Steinway Drug Bldg.	3 ea. 10 KW	3
Graphic Arts Bldg.	4 ea. 25 KW	8
Walton Motors	2 ea. 20 KW	2
Chicagoan Hotel	3 ea. 27½ KW	4
1520 North State Building	2 ea. 40 KW	4
Canterbury Apts.	3 ea. 14 KW	3
541 Van Buren Street Building	2 ea. 20 KW	3
Superior Elevator Co.	1 ea. 7 KW	1
540 E. Walton Building	1 ea. 7 KW	1
Clinton Machine Co.	3 ea. 10 KW	2
Western Electric Building	2 ea. 30 KW 1 ea. 24 KW 1 ea. 10 KW	8
Marzola Drug Company	1 ea. 10 KW	1
[illegible] Building	3 ea. 14 KW	4
[illegible] Furniture Company	1 ea. 10 KW	1
116 E. Pearson Street Building	3 ea. 20 KW	4
[illegible] Stereotype	1 ea. 30 KW	2
[illegible] Service Company	1 ea. 20 KW	4
[illegible] Hotel	4 ea. 25 KW	5
[illegible] Hotel	4 ea. 25 KW	4

WHEN THE POWER COMPANY changed over to alternating current in certain Chicago areas it meant that existing elevators operating on D.C. had to be converted fast, or the good people of the town would be "grounded."

Ther Electric & Machine Works of Chicago solved elevator rectification problems for considerably more than 100 famous buildings in the Windy City by designing complete power supply and regenerative braking equipment employing SELETRON rectifiers. The illustration shows a typical 3 bank unit with regenerative control, built for the Clinton Realty Co.

Of course, elevator operation is but one of many uses for SELETRON. These rugged, efficient selenium rectifiers are versatile – useful in hundreds of varying industrial applications for economical conversion of alternating current to D.C.

Rectifier stacks for military prototypes will be furnished promptly . . . Send us your specifications, and write us for SELETRON Bulletin No. 104-D-2.

Seletron

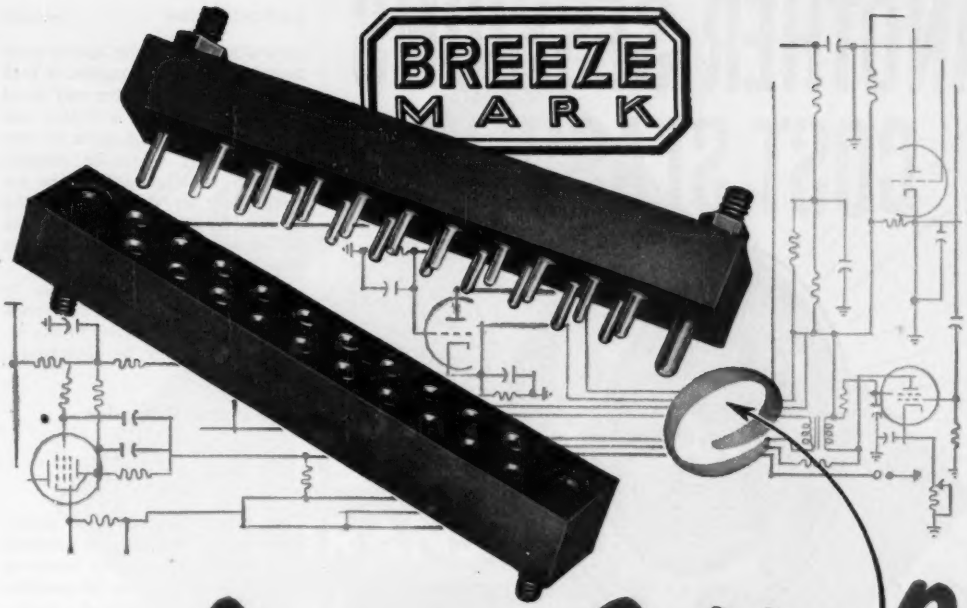
SELETRON DIVISION

RADIO RECEPTOR COMPANY, INC.

Since 1922 in Radio and Electronics

Sales Dept: 251 West 19th St., New York 11, N. Y.

Factory: 84 North 9th St., Brooklyn 11, N. Y.



Connector Problem?

...We'll take it from HERE

Good ideas for electronic circuitry sometimes run afoul of connector problems. Maybe existing connector units won't hold air pressure gradients, won't stand the heat, aren't rugged enough for the job. Or maybe it's a question of altitude, or under-water application. But if you can sketch the circuit, we'll take it from there. We've engineered so many special connectors, solved so many "impossible" problems, that whatever the requirements are, we can usually provide the answer.

Lightweight actuators for any requirement.

Job engineered, welded-diaphragm bellows.

Flexible conduit and ignition assemblies.

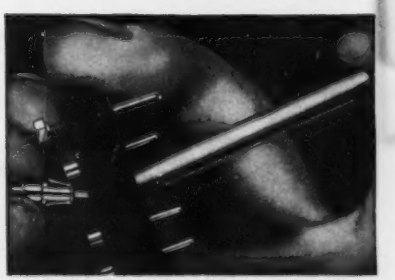
Aero-Seal vibration-proof hose clamps.

WRITE TODAY for specific information, or send us your sketches. We'll forward recommendations promptly.

BREEZE
Special CONNECTORS

BREEZE CORPORATIONS, INC.

41 South Sixth Street — Newark, New Jersey



Removable pins in Breeze connectors speed soldering, save time, trouble. Pins snap back into block.

ANOTHER SESSIONS COST SLASHER!

● Here's the latest thing in Sessions-equipped clock radios, designed to sell at lower-than-ever prices in a cost-conscious market.

The Sessions W49 Clock Movement (not a switch timer) is especially designed for panel mounting. Time is set from the front by a knob at the six o'clock position. Custom styling, including luminous treatment, is available on large quantity orders. Be sure to take advantage of this Sessions money-saver in your new clock radios, TV lamps, and other products.

Sessions Switch Timers for operating radios or TV sets, including sleep switch and other features, are available at low cost for automatic installations. Famous Sessions kitten-quiet clock and switch-timer movements are fully guaranteed. Write for details. The Sessions Clock Company, Dept. 43, Forestville, Connecticut.

SESSIONS W49 Clock Movement

See Our Exhibit at the IRE Show March 3-6, 1952 Space 419-420

normally have equally spaced horizontal lines, a misalignment of both vertical linearity and ion trap would not be noticed with a station test pattern, because the error in vertical linearity would be compensated by misalignment of the ion trap. The bar pattern from the Videometer would show up this defect on the screen of the picture tube, however.

Since the pattern generator is calibrated in terms of microvolts of output, the sensitivity of the receiver can readily be determined.

High-Speed Recorder

By Leo Rosen
Department of Defense
Washington, D. C.

THIS ARTICLE describes two essentially similar recorders for printing hard copy, one printing numbers only, the other printing 36 symbols.

The recorder consists of a multiple selection and printing mechanism and a paper-feed mechanism. The printing mechanism accepts and prints 40 characters in parallel, the printing being accomplished without stopping the print wheel. The paper remains stationary during printing. The paper-feed mechanism is controlled independently from the printing mechanism and causes the paper to advance approximately ½ of an inch.

The entire cycle of printing and paper advance is completed in 0.068 sec and therefore the recorder is capable of printing either continuously or intermittently at the rate of 15 lines per second with 40 characters to each line.

The theory of one method of

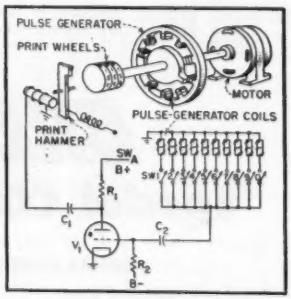


FIG. 1—Circuit using individual circuit closures

Kenyon
TRANSFORMERS
FOR STANDARD AND SPECIAL APPLICATIONS

KENYON TRANSFORMERS FOR

JAN Applications
Radar
Broadcast
Atomic Energy Equipment
Special Machinery
Automatic Controls
Experimental Laboratories

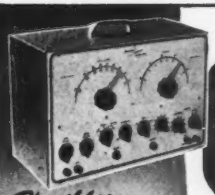
For more than 25 years, Kenyon has led the field in producing premium quality transformers. These rugged units are (1) engineered to specific requirements (2) manufactured for long, trouble-free operation (3) meet all Army-Navy specifications.

Write for details

KENYON TRANSFORMER CO., Inc.
840 Barry Street, New York 59, N. Y.

See us at Booth 56
Radio Engineering Show

New 1952 HEATHKITS



Heathkit TELEVISION GEN. KIT $39.50

Heathkit ELECTRONIC SWITCH KIT $19.50

Heathkit AUDIO GEN. KIT $34.50

Heathkit CONDENSER CHECKER KIT $19.50

Heathkit R. F. SIGNAL GEN. KIT $19.50

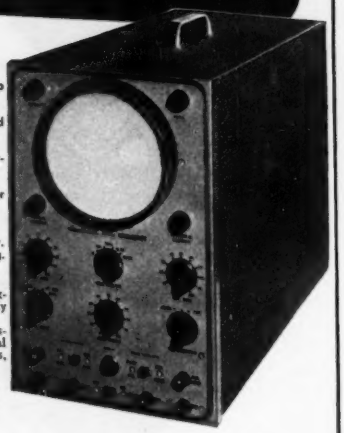
Heathkit A.C. VOLTMETER KIT $29.50

Heathkit SQUARE WAVE GEN. KIT $29.50

Heathkit INTERMODULATION ANALYZER KIT $39.50

Heathkit AUDIO FREQ. METER KIT $34.50

Heathkit 5" OSCILLOSCOPE KIT



- New "spot shape" control for spot adjustment — to give really sharp focusing.
- A total of ten tubes including CR tube and five miniatures.
- Cascaded vertical amplifiers followed by phase splitter and balanced push-pull deflection amplifiers.
- Greatly reduced retrace time.
- Step attenuated — frequency compensated — cathode follower vertical input.
- Low impedance vertical gain control for minimum distortion.
- New mounting of phase splitter and deflection amplifier tubes near CR tube base.
- Greatly simplified wiring layout.
- Increased frequency response — useful to 5 MC.
- Tremendous sensitivity .03 RMS per inch Vertical .6V RMS per inch Hor.
- Dual control in-vernier sweep frequency circuit — smoother acting.
- Positive or negative peak internal synchronization.
- Multivibrator type Wide Range Sweep Generator.

A brand new 1952 Heathkit Oscilloscope Kit with a multitude of outstanding features and really excellent performance. A scope you'll truly like and certainly want to own.

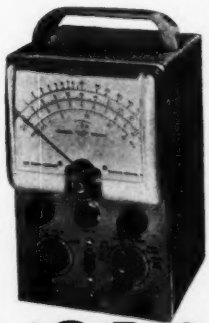
The kit is complete with all parts including all tubes, power transformer, punched and formed chassis, etc. Detailed instruction manual makes assembly simple and clear — contains step-by-step instructions, pictorials, diagrams, schematic, circuit description and uses of scope. A truly outstanding value.

MODEL O-7

SHIPPING WT. 24 LBS.

$43.50

Heathkit VACUUM TUBE VOLTMETER KIT



- New styling — formd case for beauty.
- New truly compact size — Cabinet 4⅛" deep x 4-1/16" wide x 7⅜" high.
- Quality Simpson 200 microamp meter.
- New ohms battery holding clamp and spring clip — assurance of good electrical contact.
- Highest quality precision resistors in multiplier circuit.
- Calibrates on both AC and DC for maximum accuracy.
- Terrific coverage — Reads from ½V to 1000V AC, ½V to 1000V DC, and .1 to over 1 billion ohms resistance.
- Large, clearly marked meter scales indicate ohms, AC Volts, DC Volts, and DB — has zero set mark for FM alignment.
- New styling presents attractive and professional appearance.

The 1952 Model Heathkit Vacuum Tube Voltmeter! Newly designed cabinet combines style and beauty with compactness. Greatly reduced size to occupy a minimum of space on your work-bench. Covers a tremendous range of measurements and is easy to use. Uses only quality components including 1% precision resistors in multiplier circuit for greatest accuracy. Simpson 200 microamp meter with easy to read scales for fast and sure readings.

All parts come right with kit, and complete instruction manual makes assembly a cinch.

MODEL V-5

SHIPPING WT. 5 LBS.

$24.50

YOU SAVE BY ORDERING DIRECT FROM MANUFACTURER

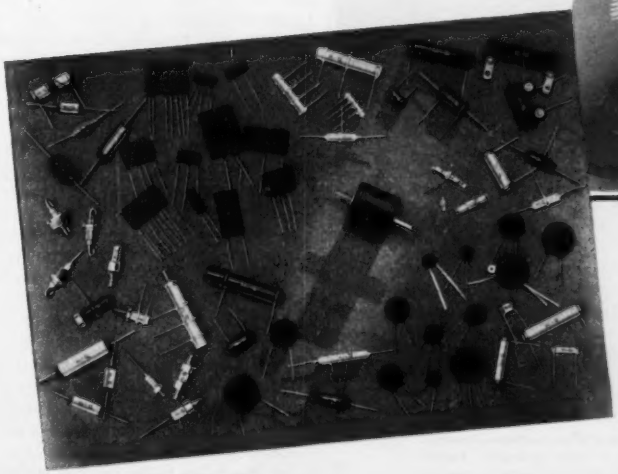
The HEATH COMPANY

BENTON HARBOR 14, MICHIGAN

HI-Q SERVES NATIONAL DEFENSE

Wherever Electronics Scan the Skies

On land, on sea and in the air, radar has given our armed forces long-distance vision the thought of which, a comparatively few years ago, would have seemed fantastic. Here, certainly, is one of the most vital applications of electronics in national defense. Here too, as throughout the entire electronics field, you will find **HI-Q** Components...ceramic capacitors, trimmers, wire wound resistors and chokes...widely used and favorably known for their dependable long life and strict adherence to specifications and tolerances. Whether your needs are for ceramic disk capacitors of either the by-pass or temperature compensating types...for tubulars, plates or the new high voltage units...or for specially designed components, **HI-Q** is ready to place its engineering and production resources at your disposal.



HI-Q HIGH VOLTAGE CAPACITORS

The ceramic slug types are available in capacities of 500 mmf ± 20% and working voltages of 20,000 V. D.C. Piercing pressure of the dielectric material is greatly increased by an exacting jacketing procedure in conjunction with a newly developed plastic with excellent arch-resistant properties. **HI-Q** high-voltage tubular capacitors are available in capacities from 25 mmf to 250 mmf with working voltages up to 7000 V.D.C. and **HI-Q** Disks are available in capacities from 50 mmf to 10,000 mmf with working voltages of 7500 V.D.C. Write for new engineering bulletin on **HI-Q** high-voltage units.

HI-Q* DIVISION

*HI-Q is a registered trademark

AEROVOX CORPORATION, OLEAN, NEW YORK, U.S.A.

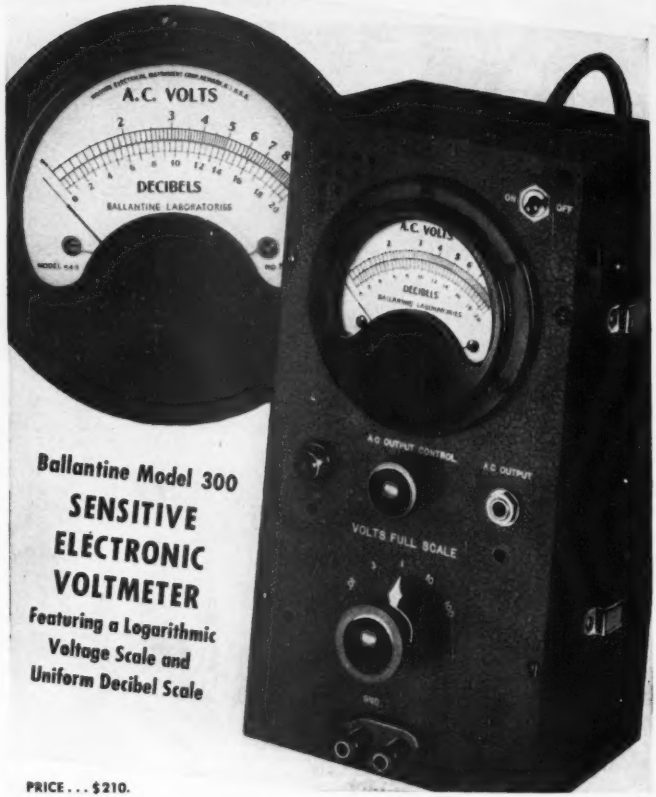
Export: 41 E. 42nd St., New York 17, N.Y. • Cable: AEROCAP, N.Y. • In Canada: AEROVOX CANADA LTD., Hamilton, Ont.

JOBBER ADDRESS: 740 Belleville Ave., New Bedford, Mass.

SALES OFFICES IN ALL PRINCIPAL CITIES

BALLANTINE

STILL THE FINEST IN ELECTRONIC VOLTMETERS



Ballantine Model 300

SENSITIVE ELECTRONIC VOLTMETER

Featuring a Logarithmic Voltage Scale and Uniform Decibel Scale

PRICE . . . $210.

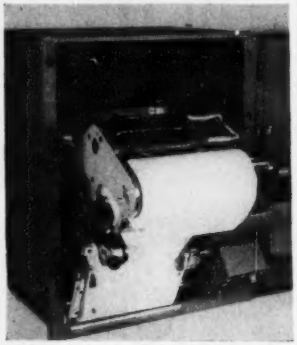
- Measures 1 millivolt to 100 volts over a frequency range from 10 to 150,000 cycles on a single logarithmic scale by means of a five decade range selector switch.
- Accuracy: 2% at *any* point on the scale up to 100 KC and better than 3% above 100 KC.
- Input Impedance: ½ megohm shunted by 30 mmfds.
- Generous use of negative feedback assures customary Ballantine stability.
- Output jack and output control permit voltmeter to be used as a flat high gain (70DB) amplifier.
- Available accessories permit range to be extended up to 10,000 volts and down to 20 microvolts.
- Available Precision Shunt Resistors convert voltmeter to microammeter covering range from 1 to 1000 microamperes.

For additional information on this Voltmeter and Ballantine Battery Operated Voltmeters, Wide-Band Voltmeters, Peak to Peak Voltmeters, Decade Amplifiers, Multipliers and Precision Shunt Resistors, write for catalog.

BALLANTINE LABORATORIES, INC.

100 FANNY ROAD, BOONTON, NEW JERSEY

Visit our booth 100 at the I.R.E. Show

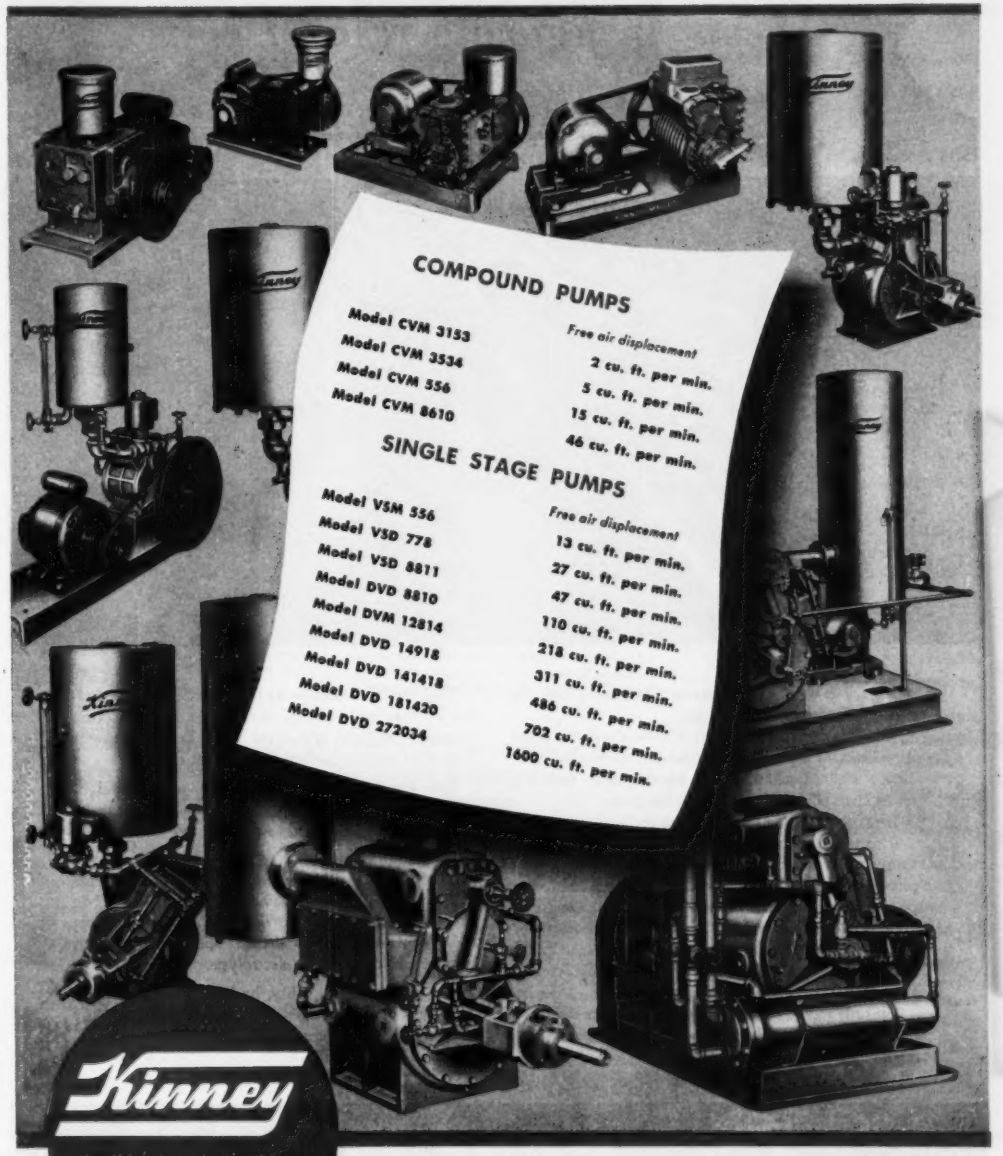


View of the recorder with the mechanism tilted out for inspection

operation is shown in Fig. 1. The motor drives the print wheels and the pulse generator rotor continuously at about 1,750 rpm. As the rotor passes each pole of the pulse-generator stator a pulse is generated in the coils. (The coils are shown for clarity both in their physical location and as circuit elements.) The character to be printed is selected by closing one of the switches SW_1, to SW_n. Capacitor C_1 is charged before printing. If SW_3 had been closed, when the pulse-generator rotor reaches L_3 a pulse is transmitted to thyratron V_1, the thyratron fires and discharges capacitor C_1 through the print hammer magnet, actuating the hammer to print when a "3" is opposite the printing point. Corrections in phasing are made either electronically by means of adjustable delay circuits or by rotating the pulse-generator stator. One set of pulse-generator coils serves all the thyratrons, there being one thyratron for each print wheel and hammer. Switch SW_4 is opened to prevent repeated printing.

Another method of operation is illustrated in Fig. 2. Here all of the pulse-generator coils are tied together and furnish a sequence of pulses to the gate which is normally open. The electronic counter associated with each print wheel is set for the value to be printed, either by actual counting, or by a transfer from some other counter. Switch SW_2 is now closed, when a pulse is received from the start-pulse generator the gate is closed. The counter receives pulses from

THE BIG LINE OF VACUUM PUMPS



COMPOUND PUMPS

	Free air displacement
Model CVM 3133	2 cu. ft. per min.
Model CVM 3534	5 cu. ft. per min.
Model CVM 556	15 cu. ft. per min.
Model CVM 8610	46 cu. ft. per min.

SINGLE STAGE PUMPS

	Free air displacement
Model VSM 556	13 cu. ft. per min.
Model VSD 778	27 cu. ft. per min.
Model VSD 8811	47 cu. ft. per min.
Model DVD 8810	110 cu. ft. per min.
Model DVM 12814	218 cu. ft. per min.
Model DVD 14918	311 cu. ft. per min.
Model DVD 141418	486 cu. ft. per min.
Model DVD 181420	702 cu. ft. per min.
Model DVD 272034	1600 cu. ft. per min.

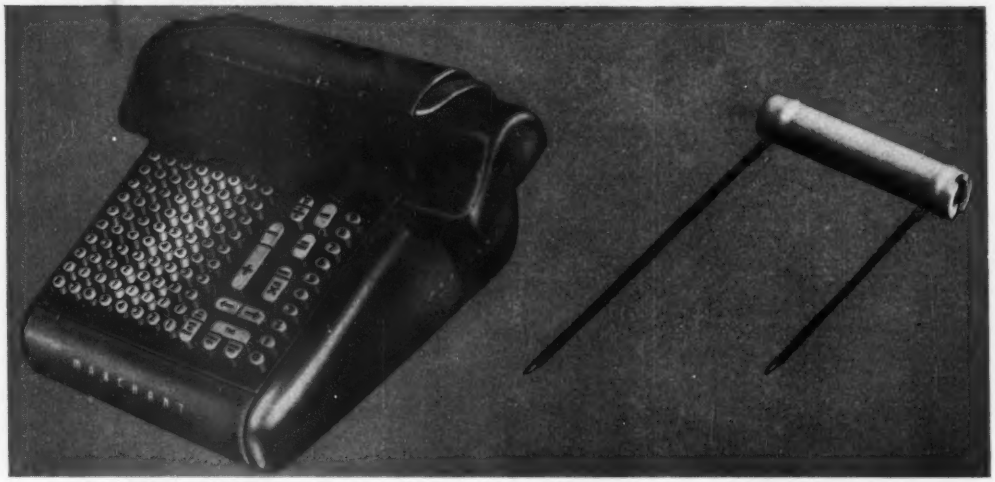
Kinney VACUUM PUMPS

There's a Kinney Pump for every vacuum requirement. Write for Bulletin V-518. Kinney Manufacturing Co., 3565 Washington St., Boston 30, Mass. Representatives in New York, Chicago, Cleveland, Philadelphia, Houston, New Orleans, Los Angeles, San Francisco, Seattle. FOREIGN REPRESENTATIVES: Gen'l Engineering Co., Ltd., Radcliffe, Lancs., England. • Harrocks, Roxburgh Pty., Ltd., Melbourne, C. I. Australia • W. S. Thomas & Taylor Pty., Ltd., Johannesburg, South Africa • Novelectric, Ltd., Zurich, Switzerland • C.I.R.E., Piazza Cavour 25, Rome, Italy.

Marchant Calculating Machine Company

"They make no mistake in figuring resistor costs"

says L. F. Church, L. F. Church Company, San Francisco, representative for Ward Leonard Electric Company



It's *cost in terms of performance* that counts with the makers of Marchant calculators.

A lot of arithmetic would be delayed if resistors failed to work in these push-button multiplication calculators. That's why Marchant insists upon quality resistors, rather than taking a chance with bargains.

How do you *tell* a quality resistor?

It's true that most resistors look alike. A resistor is a simple piece of equipment—really nothing more than a piece of ceramic tubing . . . a couple of terminals . . . a piece of resistance wire . . . and a protective coating.

But there the similarity ends, because in the *important* things that really count, resistors are miles apart! And the biggest difference is that all of the resistor is actually *made* by the company that sells it.

The only way to be sure that all components will react the same to changes in temperature is to balance their thermal characteristics.

Take the tube. Companies like Marchant are depending on that high-density, non-porous, high-dielectric strength, perfectly cylindrical Ward Leonard ceramic core, with smooth surface and straight ends.

They also know the terminals are made of the right alloy to permit proper expansion . . . and that they're securely, rigidly, clamped to the core.

They know the wire is drawn especially for their type of resistor . . . is capable of withstanding great overloads . . . has uniformly low coefficient of resistivity. They also know the coating provides a complete hermetic seal, highly resistant to thermal shock and to high humidity, acids, alkalies, electrolysis.

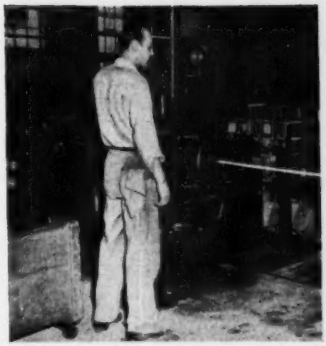
You can be sure of quality, by buying your resistors from the *one* manufacturer who manufactures, not just assembles, all the components that go into resistors. Play it safe and sound—insist upon VITROHM resistors.

WARD LEONARD

WARD LEONARD ELECTRIC COMPANY

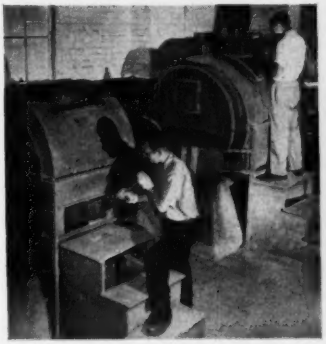
MOUNT VERNON, NEW YORK

Result-Engineered Controls Since 1892



CERAMIC CORES are made by extruding refractory material from hydraulic presses such as this in Ward Leonard's plant.

RESISTANCE WIRE sample is being processed in the combustion furnace to insure accuracy of alloy formula.



VITREOUS ENAMEL for coating is fritted, then ground to exact fineness in these revolving "ball mills."

VITROHM vitreous enamel is measured by interferometer for coefficient of thermal expansion, melting and annealing points.

Uniform Quality—Matched Thermal Characteristics—Long Service Life of VITROHM Resistors—Result From Unified Manufacture

All components of a VITROHM resistor are made by Ward Leonard, the only manufacturer who *makes*, not just assembles, all parts.

Vitreous enamel coating and ceramic cores are formulated and made by Ward Leonard—wire is drawn to their specifications.

This means that all parts are uniform in quality, balanced in respect to thermal coefficient of expansion.

There's no loosening, no failure, due to unbalance of thermal characteristics, heat affects all parts the same way, which in turn means longer life.

VITROHM resistors will stay on the job under the most adverse operating conditions where a less carefully made resistor would break down. Thermal shock, vibration, corrosive atmosphere, overloads, even prolonged exposure to humidity and electrolysis will not affect their performance.

DISTRICT OFFICES AND REPRESENTATIVES

Atlanta 5, Ga.
C. B. Rogers and Associates, 1000 Peachtree St., N. E.

Baltimore 18, Maryland
Durling Electric Co., 2322 No. Charles St.

Charlotte 1, No. Carolina
James L. Highsmith & Co., P. O. Box 1011

Chicago 4, Illinois
Ward Leonard Electric Co., 53 West Jackson Blvd.

Cincinnati 2, Ohio
Sheldon Storer and Assoc., Trans. Bldg., 307 E. 4th St.

Cleveland 14, Ohio
The Ambos-Jones Co., 1085 The Arcade

Corpus Christi, Texas
Branco-Krochy Co., Inc., 126 North Staples St., P. O. Box 443

Denver 2, Colorado . . . Mark G. Mueller, 1644 Blake St.

Detroit 21, Michigan
Jesse W. Eakins Co., 16575 James Couzens Highway

Hartford 6, Conn.
Ward Leonard Electric Co., 37 Webster St.

Houston 1, Texas
Branco-Krochy Co., Inc., 4411 Navigation Blvd. P. O. Box 1734

Kansas City 2, Mo. . . Henry E. Battis Co., 406 W. 34th St.

Knoxville, Tenn.
John G. Pattyjohn, 1243 North Broadway, P. O. Box 395

Los Angeles 13, Calif.
Ward Leonard Electric Co., 420 So. San Pedro St.

Memphis 3, Tenn.
E. E. Turkell, 198 So. Main St., P. O. Box 4029

Minneapolis 5, Minn.

Newark 2, N. J.
Marvin H. Kirkaby, 437 Oliver Ave., S.
Ward Leonard Electric Co., 1060 Broad St.

New Orleans 13, La.
Electron Engineering Co., 1858 Constance St.

Philadelphia 2, Pa.
Ward Leonard Electric Co., 112 South 16th St.

Pittsburgh 16, Pa. W. A. Bittner, 3845 W. Liberty Ave.

Roanoke, Va. . Lynn H. Morris, 2683 Dorchester Dr., Rt. 2, P. O. Box 5097

Rochester 7, N. Y.
Ward Leonard Electric Co., 66 South St.

St. Louis 10, Mo.
Ward Leonard Electric Co., 4030 Chouteau Ave.

Salt Lake City 1, Utah

San Antonio, Texas
Leonard M. Shuster, 318 Dooly Bldg.
Branco-Krochy Co., Inc., 434 Transit Tower Bldg.

San Francisco 3, Calif. L. F. Church Co., 750 Natoma St.

Seattle 4, Wash.
Northwestern Agencies, Inc., 4130 First Ave., So.

Tucson, Arizona
Central Station Equipment Co., 2323 Aviation Highway

Washington 5, D. C.
Federal Engineering Co., Inc., 1109 K. St., N. W

CANADA

Edmonton, Alta . . . . . D. M. Fraser, Ltd., 10627-101 St.

Halifax, N. S. . . . . D. M. Fraser Ltd., 702 Dahie St.

Montreal 25, P. Q.
D. M. Fraser, Ltd., 1570 St. Matthew St.

Toronto 1, Ont. . . . D. M. Fraser, Ltd., 54-56 Lombard St.

Vancouver, B. C. . . . D. M. Fraser, Ltd., 716 Cambie St.

Winnipeg, Man. . . . . D. M. Fraser, Ltd., 401 Ave. Bldg.

EXPORT

New York 4, N. Y. . . . Ad. Auriema, Inc., 89 Broad St.

the pulse generator. When the counter carries, the thyratron is fired and printing occurs. For example, to print "3", the counter is preset to "3". After 7 pulses the thyratron fires and the hammer strikes when "3" is at the printing station. (The print wheels are engraved so that the numbers run in reverse sequence to the direction of rotation.)

Paper movement is controlled by means of a separate circuit which is triggered after all the characters for one line have been printed. Thus data appearing in one line need not be printed at the same time.

The numeric printer has a ten-pole pulse generator and ten-character type wheels, while the alpha-numeric printer has a 36-pole pulse generator and 36-character type wheels. The principle of operation and the remaining construction are substantially the same.

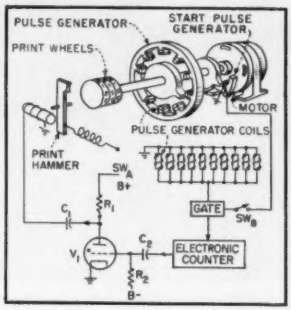


FIG. 2—Circuit using electronic counters for control

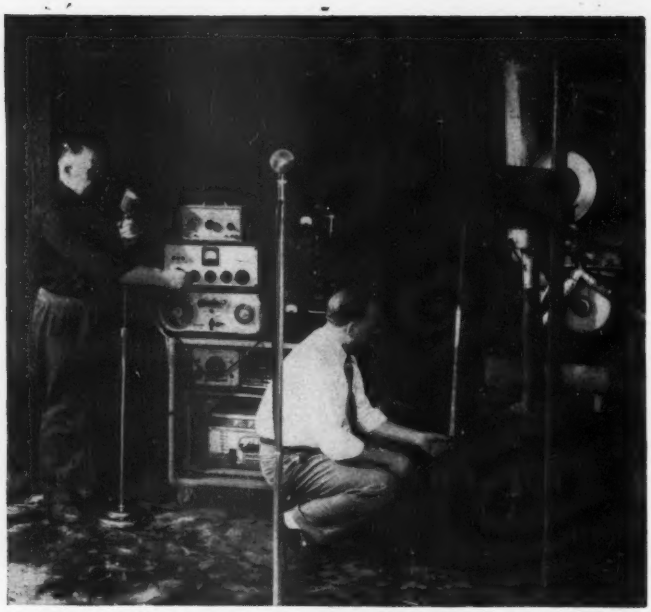
Auxiliary Circuits

Practically any type of electronic counter including decade counting or binary with feedback for decade counting can be used to drive the printer.

Circuits are available for converting a voltage into a decimal number and thus the output of a strain gage or other varying voltage can be recorded directly.

Some of the print wheel positions can be reserved for a serial number, while other positions can be reserved to indicate the actual time a reading is taken to a degree of accuracy limited only by the time standard available.

The application of the described



TESTING OF MUFFLERS at the Donaldson Co., St. Paul, Minn., is simplified with recording equipment tailored to the job by Donaldson engineers. Comparative performances recorded on tape can be played over and over again for analysis.

Sound Recording problems? 3M Engineers can help you!

Technical assistance on every phase of sound recording is yours for the asking from the 3M Service Organization. This group of over 100 sound engineers has had wide experience with radio, television and industrial users of sound recording equipment. Backed by the extensive facilities of the 3M Laboratories, they're ready to help with your recording problems, show you shortcuts and new techniques, assist in the selection of equipment.

Call your local 3M Service Representative today . . . or write us direct: Dept. E-32, Minnesota Mining & Mfg. Co., St. Paul 6, Minn. No obligation, of course.

HERE'S WHY RECORDING ENGINEERS USE MORE "SCOTCH" SOUND RECORDING TAPE THAN ALL OTHER BRANDS COMBINED

- Lower noise level than any other tape
- Greater output sensitivity than any other tape
- Better reel-to-reel uniformity than any other tape
- Erases cleaner than any other tape
- No curling or cupping—always lies flat on head
- Lubricated for longer tape life

The term "SCOTCH" and the plaid design are registered trademarks for Sound Recording Tape made in U.S.A. by MINNESOTA MINING & MFG. CO., St. Paul 6, Minn.—also makers of "Scotch" Brand Pressure-sensitive Tapes, "Underseal" Rubberized Coating, "Scotchlite" Reflective Sheeting, "Safety-Walk" Non-Slip Surfacing, "3M" Abrasives, "3M" Adhesives. General Export: Minn. Mining & Mfg. Co., International Division, 270 Park Avenue, New York 17, N. Y. In Canada: Minn. Mining & Mfg. of Canada, Ltd., London, Canada.

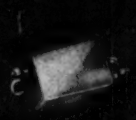
NF10262
Hermetically sealed vehicular suppressor; conforms with Signal Corps spec's.

NF1A142
Extra heavy duty, hermetically sealed, corrosion proof filter; 350 amp. capacity.

NF1A084
Heavy duty, hermetically sealed, corrosion proof filter of feed-through design.

NF1C203
An efficient single pi filter for industrial, marine and aircraft service.

NF1A197
For low-current applications where space is limited.



NF10270
Metallized paper construction for high capacity, low voltage applications.

IN INTERFERENCE FILTERS!

There's a standard C-D QUIETONE filter for practically every known application,
engineered by the largest filter laboratory in the world.
If your problem is a brand new one, our filter engineers will be glad to collaborate with you! Write Dept. K-32, for full information
Cornell-Dubilier Electric Corp., South Plainfield, N. J.

1910-1951

SUBSIDIARY

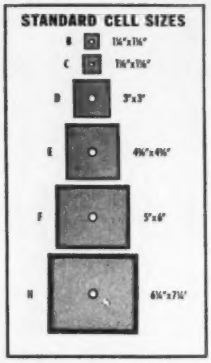
CONSISTENTLY DEPENDABLE
CORNELL-DUBILIER
CAPACITORS

PLANTS IN SOUTH PLAINFIELD, N. J.; NEW BEDFORD, WORCESTER, AND CAMBRIDGE, MASS.; PROVIDENCE, R. I.; INDIANAPOLIS, IND.; FUQUAY SPRINGS, N. C.; AND SUBSIDIARY, THE RADIART CORP., CLEVELAND, OHIO

International

Selenium Rectifiers

for unsurpassed performance



POWER RECTIFIERS
Ratings up to 250 KW
Efficiency to 87%—
Power Factor 95%

Over 500,000 KW, DC Power, is operated with *International* Selenium Rectifiers. A recent month's production included Rectifiers to supply 40 microamperes, 1,000 volts, and Rectifiers with a capacity of 140,000 amperes, 14 volts. Designed and built to meet Government Specifications. Manufactured for temperatures up to 100° C ambient—100% humidity. Owned and managed by Engineers who are specialists in the design and manufacture of Selenium Rectifiers. Submit your problems for analysis and we will be glad to offer our recommendations.

Photo-Electric Cells
Self-Generating Type
Output up to 600 microamperes at 100 foot-candles illumination and 100 ohms external resistance.

Hermetically Sealed Rectifiers
Cartridge Type—up to 60 ma., 9,000 volts per cartridge.

High-Voltage Rectifiers
Cartridge Type—up to 60 ma., 9,000 volts per cartridge.

Miniature Rectifiers
From 65 to 1,000 ma.

International
RECTIFIER CORPORATION

GENERAL OFFICES:
1521 E. Grand Ave.
El Segundo, Calif.
Phone El Segundo 1890

CHICAGO BRANCH OFFICE:
205 W. Wacker Dr.
Franklin 2-3889

IDEAS *in the making*!

Ardux Bonding Resins and Araldite* Bonding, Casting and Coating Resins developed by Ciba Research are simplifying manufacturing methods, improving product efficiency, and opening new fields of product development. You will want to know more about them.*

DURABLE, ACCURATE ALIGNMENT, WITH ECONOMICAL ARALDITE GLASS-TO-METAL SEAL . . .

improves performance efficiency and practical operation of this Electron Injector for a specially designed 100 MeV Betatron unit.

ARALDITE RESINS,

used to make these glass-to-metal seals permit more accurate alignment than that achieved with the less effective and more costly bonding agent used previously.

ARALDITE
Bonding Resins

serve the electrical and electronic industries in many important ways . . . bonding metal supports to insulators, and such heat resistant materials as asbestos and graphite to aluminum and steel. In addition, the exceptional electrical properties of Araldite *Casting* Resins are effectively used for high voltage capacitators, in transformers weighing many pounds, and the filling and embedding of electrical apparatus such as between wires of frequency filter cases.

IDEA GENERATORS!

Design and Production Engineers seeking new, improved simplified time-and-money saving means to better results, will find in Araldite Ethoxyline Resins an exceptional opportunity to put their ideas to work. Araldite Bonding, Casting and Coating Resins are fully described in a new series of technical manuals, which may be obtained by mailing this coupon, or writing in greater detail on your Company letterhead concerning your product problems.

* Reg. U. S. Pat. Off.

Ciba *Plastics*

★ BONDING ★ CASTING
★ COATING RESINS

CIBA COMPANY INC., PLASTICS DIVISION
627 Greenwich St., New York 14, N. Y.
(In Canada: Ciba Co. Ltd., Ciba Bldg., Montreal)
Please send me Ciba Plastics Technical Bulletins for
BONDING ☐ CASTING ☐ COATING ☐

*Name*_____
*Company*_____ *Title*_____
*Address*_____

when you need a

SIE

SPECIFICATIONS

Range: 1 cps to 120,000 cps
Calibration: within 1½% plus 1/10 cycle
Output circuits: 20 volts or 20 milliamps and 1 volt at 300 ohms constant impedance
Amplitude stability: Plus or minus ½ db
UNDESIRED VOLTAGES
Power Supply Noise: Less than 1 100% of output signal
Power Line Surge: Less than 1/10% of output signal
Harmonic Distortion: Less than 2 10% from 20 cps to 15,000 cps. Less than 1% at all other frequencies
Microphonic Noise: Less than 1/100% of output signal

SOUTHWESTERN INDUSTRIAL ELECTRONICS CO.

2831 POST OAK ROAD
HOUSTON 19 TEXAS

434 SEVENTH AVE. EAST — CALGARY, ALBERTA, CANADA

recorder as an output device for digital or analog computers is obvious. In programs where the recording time is small compared to computation time, the recorder consolidates the data into adjacent lines. In programs where computation is rapidly accomplished, the recorder is capable of printing up to 600 characters per second.

Through the use of appropriate converters, data such as strain-gage readings, which might otherwise have to be recorded on an oscillograph, can be printed directly. A great saving in man hours of oscillograph chart interpretation may be effected by this means. The exact time of the record is also recordable by devoting the proper number of print wheels to this function. Because the paper-feed mechanism is controlled independently, two readings from one gage can be taken on one line. For example, it is possible to record using two significant figures per gage, the output of 20 gages every 0.068 millisecond or the output of 10 gages every 0.034 millisecond.

Application to communications or telemetering with up to 600 characters per second are possible. The described recorder may also be used to print from punched cards and perforated or magnetic tape. For example, in preparing address labels or accounting data.

The author wishes to acknowledge the contributions of H. C. Barlow and R. Bowman of the Department of Defense, and the Anderson-Nichols Company of Boston in the development of the recorders described.

Economical Selective Calling Circuits

By FRED M. BERRY
Engineering Consultant
Electronics Department
University of Kansas Medical Center
Kansas City, Kansas

THE BASIC method to be described is not claimed to be original by the author and is believed to have been used for ship-to-shore signaling and also in two-way dialing equipment over land lines. The actual circuitry described, however, is believed to have merit on a cost and reliability basis.

The basic method is shown in

It makes tubes more reliable ...at less cost

SHOWN here, almost natural size, is DPi's new MB-10 Booster Diffusion Pump combined with a new port-and-valve unit. It's compact enough for any rotary exhaust machine, and it gives a big boost in performance—two ways.

1. This pump gives you a vacuum higher than 0.1 micron Hg at the tubulation before getter flash and in less time than other diffusion pumps of comparable size. Results: less residual gas to be gettered, less getter required, less getter deposited to affect operating characteristics, less gas that can be released from the getter to shorten tube life.

2. Despite the high ultimate vacuum, the pump tolerates high enough forepressure so that it can be installed in almost any rotary machine without extensive changes in slide valve and sweeps. For larger tubes, the port-and-valve can be adapted to permit rough pumping independently of the diffusion pump.

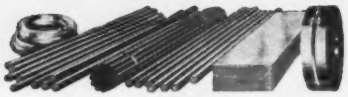
The unit is designed for easy installation of a leak detector to check bad seals or machine leaks. Valving is done mechanically, requiring no electrical circuits. The pump jet is specially designed for easy cleaning.

For complete engineering data, write to ***Distillation Products Industries,*** Vacuum Equipment Department, 727 Ridge Road West, Rochester 3, N. Y. (Division of Eastman Kodak Company).

high vacuum research and engineering

DPi

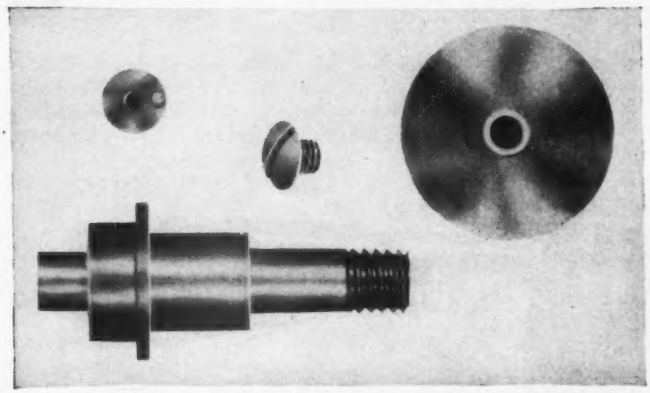
Also . . . vitamins A and E . . . distilled monoglycerides . . . more than 3500 Eastman Organic Chemicals for science and industry



BRIDGEPORT BRASS COMPANY

COPPER ALLOY BULLETIN

"Bridgeport" BRASS CO. MILLS IN BRIDGEPORT, CONN. AND INDIANAPOLIS, IND.—IN CANADA: NORANDA COPPER AND BRASS LIMITED, MONTREAL



Four examples of short-run jobs turned out in screw machines at costs below "tool-room" methods. Free-turning brass rod was used—Courtesy Parsons Screw Products Co., Naugatuck, Conn. (Mag. 2x)

Cost of Short Run Jobs Cut Through Use of Screw Machines

Manufacturing in the fields of electronics, instruments and servo-mechanisms generally involves small runs. At the same time, various parts are often very small and intricate, calling for extreme accuracy.

Many concerns have produced these parts by "tool-room" methods. However, there has been a decided trend in the past few years for some screw machine shops to specialize on runs of only 100 to 1000 parts. Results have shown that the cost of setting up a screw machine and running these small lots is considerably below that of the tool-room procedure.

0.0265 Hole Drilled

A good example of this is seen in the enlarged illustration. This part is only 0.090 in. long and the largest diameter is .140. The drilled hole is 0.0265 with a plus .0000, minus 0.0005, tolerance. When produced by a toolmaker, only two or three were completed in a day. Not only is this method costly, but exceedingly slow. In a screw machine this is less than a day's production and even with the cost of cams, tools and setup considered, the end cost of the parts is far below that of the tool room.

Another factor in the production of this part is that there are parallel flats on the .140 diameter with a 3/32 dimension. Rather than milling these flats on such a small piece, it proved worthwhile from the viewpoint of both cost and accuracy to have the wire drawn to shape by the brass mill. Although the print calls for a plus-minus 0.005 tolerance on these flats, greater accuracy was found in the drawn rod.

Stud Turned on Piece

The part on the left of the large illustration, made of free machining brass rod, has a stud only 3/64 in diameter close to the edge of the 7/32 main diameter. It would have proved a difficult problem to drill a small hole so close to the edge and then assemble a stud either by staking, or some other method of joining. This was also a small-run job.

After the part was turned, drilled for the center hole and cut off, it was hand fed into chuck with an off-center hole, and then the stud was turned. Since the stud was ⅛ long and the 7/32 diameter finished to a thickness of only 3/64, it was necessary to use both a rough and finishing tool.

Assembly Problem Eliminated

As a result of using screw machines not only was the price cut on the part but also on the assembly, and greater strength and accuracy was obtained in the stud.

The largest part in the illustration has five outside diameters, a trepanning of the second largest diameter and an external thread. There are two inside diameters, including an internal thread on the smaller. Extreme accuracy was required on the large hole diameter as well as the depth. This was completed in a primary and one secondary operation.

The disc in the center of the illustration with the internally threaded hub has an 11/32 diameter with a thickness of 0.010. This part was completed in the primary operation and involved less than 1000 pieces. Although the leaded free-cutting brass rod had considerable temper, it was still necessary to use extreme care in the tooling to prevent bending of this thin section.

Less Than Two Threads Cut

The screw is interesting from the standpoint that although the work was done in a screw machine, the thread is less than two threads and had to come tight to the head. A self-opening diehead was used. The screw was slotted on the same machine.

For information on the choice of brass, bronze and copper for your product, consult with our laboratory as to composition, temper and form. Write to our nearest district office or to Bridgeport directly. (7863)

Brass part only 0.090 in. long with two flats on the largest diameter (0.040). Milling was eliminated by purchasing rod with flats drawn—Courtesy Parsons Screw Products Co., Naugatuck, Connecticut. (Mag. 5x)

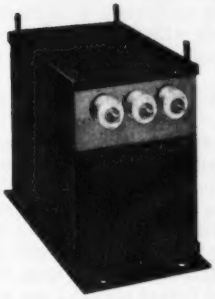
Precision Built

for the Finest Equipment

FERRANTI

Transformers

Our long experience in building all types of transformers, including hermetically sealed units, qualifies us as a dependable supply source for transformers used in military applications. We offer sound engineering and faultless craftsmanship . . . custom design with the economy and speed of modern mass production methods.



Hermetically Sealed Types for MIL-T-27 applications . . . Special Cores . . . High Temperature Insulation . . . as well as all normal types for every purpose.

FERRANTI ELECTRIC, INC.
30 Rockefeller Plaza, New York 20, New York

There is No Finer Name in Transformers than FERRANTI

PRECISION RESISTORS of Timely Importance

VERTICAL STYLE JAN-R-93

Flush terminals extending vertically from the same end of this Shallcross BX Type precision wire-wound resistor provide longer leakage path from mounting surface and simplify mounting in many applications . . . Designed to meet JAN requirements for styles RB40B, RB41B and RB42B.

HERMETICALLY-SEALED LUG-TYPE MIDGETS

Designed for JAN-R-93, characteristic A, style RB11, these resistors are only 1⅛" long x ½" diameter. Values up to 0.1, 0.3 or 0.4 megohms depending on alloy of windings. Hermetic sealing by a patented Shallcross process provides positive protection against humidity, fungus and salt water immersion.

HIGH-STABILITY TYPES

Most of the more than 50 standard Shallcross resistors can be supplied to a tolerance as close as 0.01% and with guaranteed stability of 0.003%. Shallcross also regularly supplies matched pairs and sets. Special resistors of this type require extra processing precluding possibility of quick delivery. In designing new equipment with quantity production anticipated, standard (0.05% to 1%) units are recommended for best delivery and price.

PRECISION POWER RESISTORS

Practically any standard Shallcross Akra-Ohm resistor (including miniature types) can be supplied with glass fibre insulated wire and silicone impregnation to increase power rating from 2 to 4 times while retaining accuracy and stability. Ratings range from 1 watt for miniatures to 20 watts for the largest bobbin size. Glass insulated wire limits maximum resistance available on a given bobbin to lower than usual values as tabulated in bulletin R-3b.

A complete assortment of precision wire-wound resistor sizes, styles, ranges and mountings for military or industrial use. Write on company stationery for Shallcross Akra-Ohm Engineering Bulletin R-3b to Shallcross Manufacturing Company, Collingdale, Pa.

SHALLCROSS

PRECISION RESISTOR SPECIALISTS FOR OVER 20 YEARS

See Us at the IRE Show — Booths 280-281

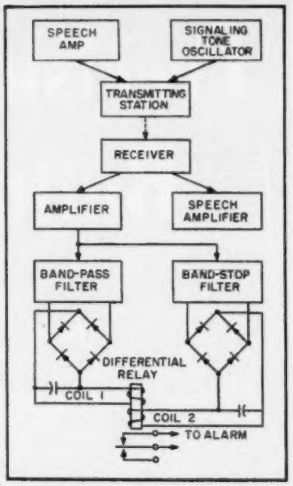
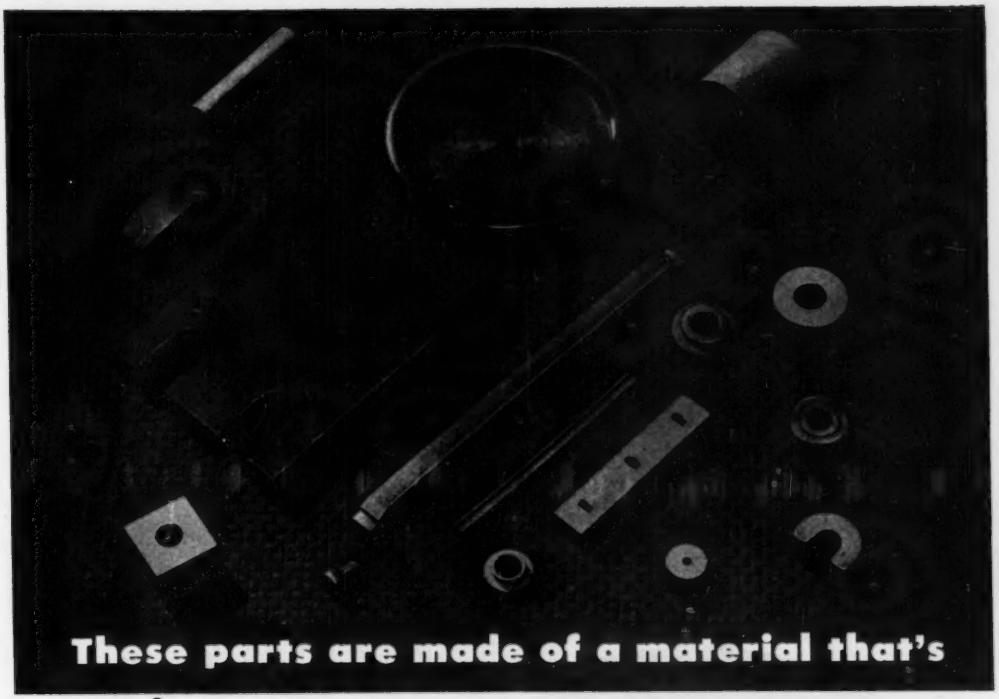


FIG. 1—Block diagram of differential-relay selective signaling system

Fig. 1. A pure tone is transmitted from the calling station. At the receiving station the tone enters the band-pass filter, is rectified and applied across coil 1 of the differential relay. The tone also is applied to the band-stop filter. If the tone is of correct frequency no current will pass and coil 2 receives no current. The relay will actuate toward contact 1 and operate the signaling device.

If voice frequencies or noise are present, the band-stop filter will pass all frequencies except the narrow band centering over the signaling tone. Since the pass filter will pass only the frequencies centering over the tone frequency, the result is that coil 2 will receive the larger current and the relay will be pulled toward contact 2 and signaling will be prevented. Thus, differential action is secured and the operation of the signaling device depends largely on the signal to "noise and speech" ratio.

If proper time delay is provided, false operation can be almost entirely prevented. The only chance for false operation is that in some voices almost pure tones lasting up to a second or more will occur. If a time delay is provided up to about two seconds this probability of false operation can be reduced greatly. One system having a time delay of from 1 to 1½ seconds has



Half the weight of aluminum!

If your product consists of parts that call for unusual physical, electrical and mechanical properties or a *combination* thereof, then you'll find no material more versatile than Taylor Vulcanized Fibre.

Here is basic cellulose material that, in addition to being extremely light in weight, is exceptionally tough and resilient. It possesses great mechanical and high dielectric strength . . . along with excellent forming qualities. It is unaffected by most solvents and is attractive in appearance.

What's more, Taylor Vulcanized Fibre can be sheared, sawed, cut, formed, punched, shaved, broached, drilled, turned, swaged, milled, tapped and machined, engraved, stamped, sanded, ground, burred, cleaned, painted and tumbled!

And, it's available in sheets, rods, rolls and coils in 7 job-proved grades, each of which has been engineered to make *your* product or part better.

Why not explore the possibilities of using Taylor Vulcanized Fibre in your product *today?* Let us tell you, too, about Taylor Phenol, Melamine and Silicone Laminates . . . and our modern fabricating facilities. Write for complete engineering data and a generous assortment of samples. There's no obligation, of course.

SINCE 1891
Taylor
LAMINATED PLASTICS

TAYLOR FIBRE CO.

NORRISTOWN, PENNA. • LA VERNE, CALIF.

VULCANIZED FIBRE

PHENOL • MELAMINE • SILICONE LAMINATES

Aircraft Instruments and Controls

Radio Communications and Navigation Equipment

For precision and dependability look to KOLLSMAN

KOLLSMAN INSTRUMENT CORPORATION

ELMHURST, NEW YORK — GLENDALE, CALIFORNIA

SUBSIDIARY OF

Standard COIL PRODUCTS CO. INC.

ONE Nichrome*

"One World." All over the globe, men have come to acknowledge this unique concept as the most effective basis for solving innumerable problems related to human progress.

"One Nichrome." All over the globe, men have come to acknowledge this unique alloy as the most effective means for solving a host of problems also related to human progress—in the fields of engineering and production.

This being so, we take particular pride in our trademark: NICHROME—granted solely and wholly to us by the United States Patent Office forty-three years ago. Representing a series of superb electrical heating and resistance alloys, developed and produced *only* by Driver-Harris, it symbolizes top quality and utmost dependability to manufacturers everywhere.

*T. M. Registered in United States Patent Office by Driver-Harris Company August, 1909

World-Famous **Nichrome** is produced only by

Driver-Harris Company

HARRISON, NEW JERSEY

BRANCHES: Chicago, Detroit, Cleveland, Los Angeles, San Francisco

Manufactured and sold in Canada by The B. GREENING WIRE COMPANY, LTD., Hamilton, Ontario, Canada

Factories: U. S. A., CANADA, ENGLAND, IRELAND, FRANCE, ITALY, SPAIN Representatives in 38 COUNTRIES

MAKERS OF THE MOST COMPLETE LINE OF ELECTRIC HEATING, RESISTANCE, AND ELECTRONIC ALLOYS IN THE WORLD

*Quality Controlled**
TO THE HIGHEST STANDARDS OF THE INDUSTRY

CHESTER
plasticord-plasticote
WIRES and CABLES

*Quality Control works 2 ways at CHESTER

It's a fact and here's why! First, Chester quality control engineers certify every phase of manufacture from raw material to finished product packed for shipment. No detail is too small or unimportant to merit their full attention. Second, quality in turn governs production—not a single foot of Chester wire or cable is ever "hurried through" to meet a shipping date or heavy schedule. Extra shifts, not faster production is the method used to break bottlenecks at Chester.

This two way quality control is just one of many important reasons why electrical and electronic men, in increasing number, specify Chester wire and cable for an extra measure of reliability. Why not check your requirements with Chester today.

FOR EVERY APPLICATION—

JAN-C-76 Approved Wires • 80°-90°-105°C Hook-Up Wire • Shielded Wire and Cable Flexible Cords • Coaxial Cable • Television Lead-In Cable • Gas Tube High Tension Cable • Oil Burner Ignition Cable • Blasting Wire • Thermostat Cable • Bell and Office Wire • TW Building and Fixture Wire

JAN-C-76 SRIR

UL APPROVED 105°C

JAN-C-76 SRRF

UL APPROVED 90°C

JAN-C-76 SRHV

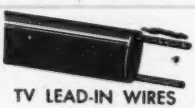
UL APPROVED 80°C

JAN-C-76 WL

SHIELDED WIRES & CABLES

FLEXIBLE CORD

INSTRUMENT WIRES


TV LEAD-IN WIRES

COAXIAL CABLE

COMMUNICATION WIRES & CABLES

SPECIAL WIRES & CABLES TO SPECIFICATION

"Chesty" says—
Rely on Plasticord and Plasticote – write for the new Catalog today

CHESTER CABLE CORP.
CHESTER, NEW YORK

MANUFACTURERS OF QUALITY WIRE AND CABLE FOR EVERY ELECTRICAL AND ELECTRONIC REQUIREMENT

been in constant use for four years with a record of only two false operations and this on the same voice.

Several signaling functions can be provided by using several tones. While the operation of the basic circuit of Fig. 1 is quite satisfactory, the cost of the two filters and the differential relay made it desirable to investigate other possible circuits.

Figure 2 is another possible circuit arrangement. Tuned circuit LC is supplied by speech and signal frequencies through Z_1. At the signaling frequency the tuned circuit LC is in antiresonance and has an effective parallel impedance of several times that of Z_1. At frequencies off resonance the impedance of LC drops to be equal to or less than that of Z_1. Diodes D_1 and D_2 rectify the voltage drops occurring across Z_1 and LC respectively. These two resultant d-c voltages are in series as indicated by the plus and minus signs of Fig. 2 and thus the difference of the two voltage drops are applied to relay tube V_1. If noise or speech is the larger component of the incoming signal, a negative voltage is the result at grid of V_1, while if a signaling tone predominates, the voltage will be positive and relay will be actuated. Capacitors C_2 and C_3 and resistors R_1 and R_2 also provide desirable time constants from the two diodes so that sustained speech tones will not actuate the relay.

The circuit of Fig. 3 retains the more selective advantage of Fig. 1 at only a slight increase in components. Referring to Fig. 3, the speech channel with tone frequencies are applied to primary of T_1. Output winding of T_1 is center-tapped and is part of a hybrid or

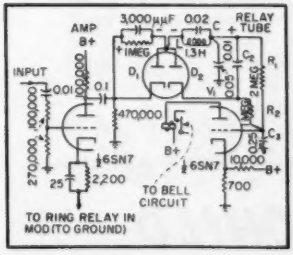
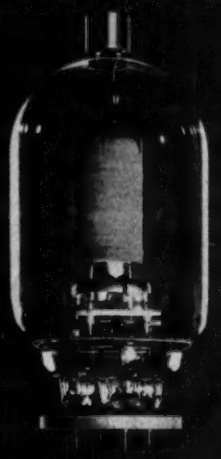


FIG. 2—Simplified differential system has advantages for single-frequency operation

Completely New!

CLIPPER DIODE 719A



NEW! EXCLUSIVE SINTERCOTE* ANODE

NEW! LARGE STURDY CATHODE STRUCTURE

nine lives plus

Ample cathode for high pulse-peak emission makes the Los Gatos 719A diode ideal for clipper use in radar and similar pulse applications, where long service life is important. Lewis and Kaufman tube engineering emphasizes longevity at every critical point.

for high pulse-peak emission

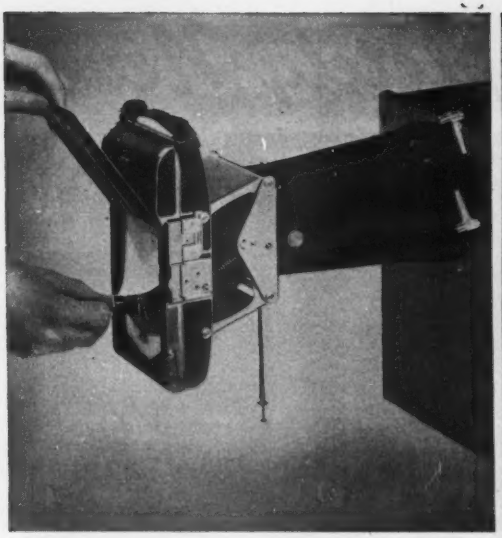
Completely redesigned, the new Los Gatos 719A eliminates all internal insulators across high-voltage points. Efficient heat dissipation is provided by the new black-body Sintercote* anode.

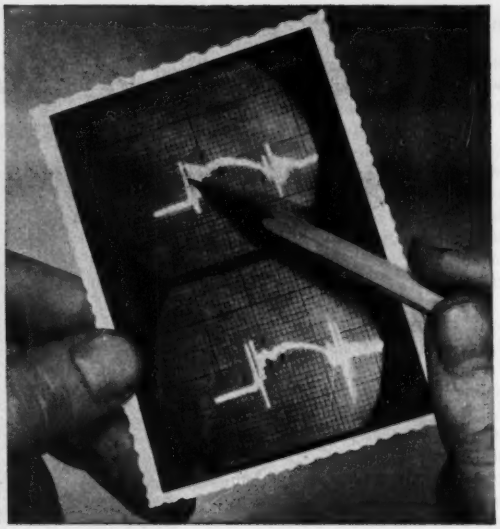
There is a field representative nearby to serve you. Send for details.

*Trademark

LEWIS AND KAUFMAN, INC.

LOS GATOS CALIFORNIA





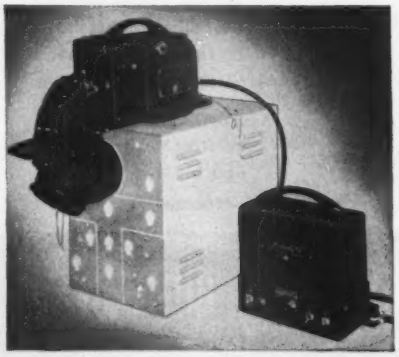
EASY TO TAKE...EASY TO READ

with the Fairchild-Polaroid® Oscilloscope Camera

ELECTRONIC CONTROL GIVES INFINITE SPEED VARIATION

with the Fairchild Oscillo-Record Camera

For both still and continuous-motion recording on 35-mm film or paper, the Fairchild Oscillo-Record Camera is ideal. Continuously variable speed control is provided through electronic regulation. There are no belts or pulleys. Film is sprocket-driven so there is no slippage. Top-of-scope mounting eliminates need for tripod and keeps scope controls easily accessible. There is provision for three film lengths—100, 400, or 1000 feet.



Fairchild's adaptation of the Polaroid-Land camera gives you more than just a fast photographic print of an oscilloscope image. The print is *exactly* half-size for easy measurement of values, especially when a grid is used. And you see the image exactly as it appears on the scope—not reversed. Each 3¼ x 4¼ print records two images.

Moreover, it takes only two minutes (less, if you're fast) to set up the camera, snap the shutter, and pull the tab. Then you wait one minute more and remove the finished print. It's as simple as 1-2-3. No focusing, no special training required.

Full information about the Fairchild-Polaroid and Fairchild Oscillo-Record Cameras is available on request. Write today to *Fairchild Camera and Instrument Corporation, 88-06 Van Wyck Boulevard, Jamaica 1, New York, Department 120-17A1*

Visit our exhibit at Booth 238-239 at the I.R.E. show

FAIRCHILD

OSCILLOSCOPE RECORDING CAMERAS

SCINFLEX

ASSURES YOU THE LOWEST VOLTAGE DROP IN THE INDUSTRY!

When operating conditions demand an electrical connector that will stand up under the most rugged requirements, always choose Bendix Scinflex Electrical Connectors. The insert material, an exclusive Bendix development, is one of our contributions to the electrical connector industry. The dielectric strength remains well above requirements within the temperature range of −67°F to +275°F. It makes possible a design increasing resistance to flashover and creepage. It withstands maximum conditions of current and voltage without breakdown. But that is only part of the story. It's also the reason why they are vibration-proof and moisture-proof. So, naturally, it pays to specify Bendix Scinflex Connectors and get this extra protection. Our sales department will be glad to furnish complete information on request.

• Moisture-Proof • Radio Quiet • Single Piece Inserts • Vibration-Proof • Light Weight • High Insulation Resistance • High Resistance to Fuels and Oils • Fungus Resistant • Easy Assembly and Disassembly • Fewer Parts than any other Connector • No additional solder required.

The Finest
ELECTRICAL CONNECTOR MONEY CAN BUY!

BENDIX SCINFLEX ELECTRICAL CONNECTORS

Bendix

SCINTILLA MAGNETO DIVISION of Bendix AVIATION CORPORATION
SIDNEY, NEW YORK

Export Sales: Bendix International Division, 72 Fifth Avenue, New York 11, N. Y.

FACTORY BRANCH OFFICES: 118 E. Providencia Ave., Burbank, Calif. • Stephenson Bldg., 6560 Cass Ave., Detroit 2, Michigan • Brouwer Bldg., 176 W. Wisconsin Avenue, Milwaukee, Wisconsin • 582 Market Street, San Francisco 4, California

Laboratory Standards

Model 65-B

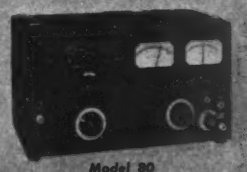
STANDARD SIGNAL GENERATORS

MODEL	FREQUENCY RANGE	OUTPUT RANGE
65-B	75 Kc.-30 Mc.	0.1 microvolt to 2.2 volts
78	15-25 Mc.; 195-225 Mc. 15-25 Mc.; 90-125 Mc. other ranges on order	1 to 100,000 microvolts
78-FM	86 Mc.-108 Mc.	1 to 100,000 microvolts
80	2 Mc.-400 Mc.	0.1 to 100,000 microvolts
82	20 cycles to 200 Kc. 80 Kc. to 50 Mc.	0-50 volts 0.1 microvolt to 1 volt
84	300 Mc.-1000 Mc.	0.1 to 100,000 microvolts
90	20 Mc.-250 Mc.	0.3 microvolt to 0.1 volt

Model 78-FM

U.H.F. OSCILLATOR

MODEL	FREQUENCY RANGE	OUTPUT RANGE
112	300 Mc. — 1000 Mc.	Maximum varies between 0.3 volt and 2 volts. Adjustable over 40 db range.



Model 80

SQUARE WAVE GENERATOR

MODEL	FREQUENCY RANGE	WAVE SHAPE
71	Continuously variable 6 to 100,000 cycles	Rise time less than 0.2 microseconds with negligible overshoot

U.H.F. RADIO NOISE and FIELD STRENGTH METER

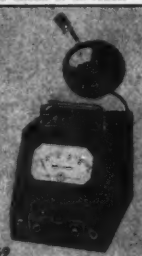
MODEL	FREQUENCY RANGE	INPUT VOLTAGE RANGE
58	15 Mc. to 150 Mc.	1 to 100,000 microvolts in antenna. 1 to 100 microvolts on semi-logarithmic output meter, balanced resistance attenuator with ratios of 10, 100 and 1000 ahead of all tubes.

MEGACYCLE METER

MODEL	FREQUENCY RANGE	MODULATION
59	2.2 Mc.—400 Mc. FREQUENCY ACCURACY Within ±2%	CW or 120 cycles fixed at approximately 30%. Provision for external modulation

CRYSTAL CALIBRATOR

MODEL	FREQUENCY RANGE	HARMONIC RANGE
111	250 Kc. — 1000 Mc. FREQUENCY ACCURACY ±0.002%	.25 Mc. Oscillator: .25-450 Mc. 1 Mc. Oscillator: 1-600 Mc. 10 Mc. Oscillator: 10-1000 Mc.



Model 59

VACUUM TUBE VOLTMETERS

MODEL	VOLTAGE RANGE	FREQUENCY RANGE
62	0-1, 0-3, 0-10, 0-30 and 0-100 volts AC or DC	30 cycles to over 150 Mc.
62-U.H.F.	0-1, 0-3, 0-10, 0-30 and 0-100 volts AC or DC	100 Kc. to 500 Mc.
67	.0005 to 300 volts peak-to-peak	5 to 100,000 sine-wave cycles per second

Model 62

PULSE GENERATOR

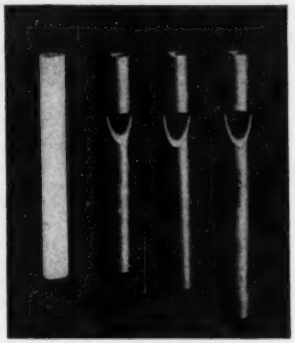
MODEL	REPETITION RATE	PULSE WIDTH
79-B	60 to 100,000 pulses per second	Continuously variable from 0.5 to 40 microseconds

MEASUREMENTS CORPORATION

BOONTON NEW JERSEY

bridge network having R_s and input impedance of band pass filter Z_1 as two arms of the bridge. Bandpass filter Z_1 is designed to have a nearly constant resistive input impedance over most of its pass band. Resistor R_1 is adjusted to have the same value as this resistive impedance over a narrow band of frequencies.

Within the pass band of the filter the hybrid network is balanced and no voltage appears between points A and B. Filter Z_1 freely passes these frequencies and diode D_2 rectifies and a positive voltage is delivered to grid of V_1. At frequencies out of pass band of Z_1 the input impedance of Z_1 is reactive and of lower impedance. Current passing



Specially-designed whistles are operated near microphone at calling station and actuate signaling equipment at selected receiving location

through Z_1 is reduced and since the hybrid network is unbalanced a voltage appears at points A and B. This voltage is rectified by D_1 which supplies a negative voltage in series with the output of D_2 and on to the grid of V_1.

This circuit allows greater tolerance to signaling tone stability. Positive signaling action is secured if the signaling tone lies within the pass band of Z_1, and noise, speech or off-frequency tones will not give false operation regardless of signal level.

This circuit was first designed to fulfill the requirements of the Missouri Public Service Company on their vhf communications circuit. About 70 mobile units and six fixed stations operating in the 30-to-40 mc band employing standard Gen-

SLANT YOUR requirements to INSTRUMENT CORP. OF AMERICA for miniature

SLIP RING AND COMMUTATOR ASSEMBLIES

This Instrument Corporation of America plant contains the most modern and complete facilities available anywhere in the world for the exclusive production of Miniature Slip-Ring and Commutator Assemblies to precision standards. It is now in full scale production to meet your requirements in the fastest possible time at the lowest possible cost.

Instrument Corporation of America Assemblies are produced under exclusive license by Electro Tec Corporation. They are manufactured by molding plastic blanks around the wire leads, then machining to the exact size and shape required, after which hard silver rings are electro-plated into the machined grooves. Final machining produces a one-piece assembly of extreme accuracy and free from errors common in fabricated assemblies.

Before placing an order for assemblies of any other type, check with us on price and quality. Our new facilities offer exceptional advantages which should not be overlooked. Our engineering staff is at your service at all times for consultation.

TYPICAL SPECIFICATIONS

Sizes: .045" to 24" Cylindrical or Flat

Cross-sections: .033" to .060" or More

Finish: Polish to 4 Micro-Inches or Better

Breakdown: 1000 V Hi-Pot Inter-Circuit

Ring Hardness: 60 to 70 Brinell

Rotation Speeds: To Over 12000 RPM

Surface Protection: Palladium and Rhodium or Gold Prevent Tarnish, Minimize Wear

INSTRUMENT CORPORATION OF AMERICA

BLACKSBURG • VIRGINIA

UNDER EXCLUSIVE LICENSE OF ELECTRO TEC CORPORATION

Anything You May Need in TAPE-WOUND CORES

RANGE OF MATERIALS

Depending upon the specific properties required by the application, Arnold Tape-Wound Cores are available made of DELTAMAX . . . 4-79 MO-PERMALLOY . . . SUPERMALLOY . . . MUMETAL . . . 4750 ELECTRICAL METAL . . . or SELECTRON (grain-oriented silicon steel).

RANGE OF SIZES

Practically any size Tape-Wound Core can be supplied, from a fraction of a gram to several hundred pounds in weight. Toroidal cores are available in fifteen standard sizes with protective nylon cases. Special sizes of toroidal cores—and all cut cores, square or rectangular cores—are manufactured to meet your individual requirements.

RANGE OF TYPES

In each of the magnetic materials named, Arnold Tape-Wound Cores are produced in the following standard tape thicknesses: .012", .008", .004", .002", .001", .0005", or .00025", as required.

Applications

MAGNETIC AMPLIFIERS
PULSE TRANSFORMERS
CURRENT TRANSFORMERS
WIDE-BAND TRANSFORMERS
NON-LINEAR RETARD COILS
PEAKING STRIPS . . . REACTORS.

WAD 3063

THE ARNOLD ENGINEERING COMPANY

SUBSIDIARY OF ALLEGHENY LUDLUM STEEL CORPORATION
General Office & Plant: Marengo, Illinois

Sylvania's Consultants in Tube Problems are set to serve your business

G. R. Sommers
Gen. Sales Manager, New York

D. W. Gunn
Manager Equipment Sales, New York

Meet the Sylvania team that goes to bat for you

Here's a competent and friendly group . . . 19 experts in radio tube and engineering problems . . . all set to serve you.

In every section of the country you'll find these Sylvania representatives and engineers ready to give you expert advice on circuits, as well as tubes. They know, or can quickly get the information about deliveries, or any other problem that's bothering you. So when you want to know about new tubes, or deliveries, or just want some good practical engineering advice . . . call in your nearest Sylvania representative or write to Sylvania Electric Products Inc., Dept. R-1403, Emporium, Pa.

DON'T MISS SYLVANIA'S EXHIBIT
BOOTHS 104-106 AT THE I.R.E. SHOW

SYLVANIA

RADIO TUBES; TELEVISION PICTURE TUBES; ELECTRONIC PRODUCTS; ELECTRONIC TEST EQUIPMENT; FLUORESCENT TUBES, FIXTURES, SIGN TUBING, WIRING DEVICES; LIGHT BULBS; PHOTOLAMPS; TELEVISION SETS

KLEINS

Quality pliers for radio-television-amplifier work

No. 301 KLEIN LONG NOSE PLIERS

Extra long reach of jaws permits getting into difficult places. Hardened and tempered to assure positive grip at point. Available in 5, 6 and 7 inch lengths.

No. 202 KLEIN NARROW NOSE OBLIQUE CUTTING PLIERS

One of the most useful tools in your kit. Narrow head permits use in confined places. Individually honed knives meet accurately at all points and stay sharp. Available in 5 or 6 inch sizes.

• There is a Klein Plier made for every job in wiring radios, television or sound system amplifiers. Long nose pliers that assure a tight grip even in confined spaces. Keen edged cutters that stay sharp even after continued service. Flat nose pliers, duck bill pliers, curved nose pliers—many types and sizes to meet every wiring need. By having a full selection of these quality tools, you will save valuable time in any wiring work.

This Klein Pocket Tool Guide gives full information on all types and sizes of Klein Pliers. A copy will be sent without obligation.

ASK YOUR SUPPLIER

Foreign Distributor International Standard Electric Corp. New York

"Since 1857"

Mathias **KLEIN** & Sons

Established 1857 — Chicago, Ill., U.S.A.

1200 BELMONT AVENUE CHICAGO 18 ILLINOIS

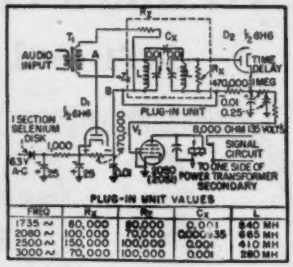


FIG. 3—Circuit of selective filter arrangement that is actuated by mouth-operated whistles

eral Electric f-m equipment. Four of the fixed stations are located at power-generating plants operated by personnel having other duties. The ambient noise is very high and speakers were not satisfactory.

It was desired to actuate an automobile horn as a signaling device at these locations to overcome the high ambient noise. It was desired to initiate a call from any of the mobile stations and to signal at will any one of the four fixed stations. Due to the large number of calling stations, it was desirable to simplify as much as possible this portion of the equipment. Each mobile transmitter could be equipped with an oscillator tunable to the signaling tones. However, cost and the necessity of modifying the mobile transmitter led to the design of the signaling whistles. Considerable experimental work was necessary to produce a whistle having a pure tone and satisfactory frequency stability. Certain designs had a tendency to change frequency over wide limits depending on how hard it was blown. Some would change modes of oscillation and jump rapidly from one frequency to another.

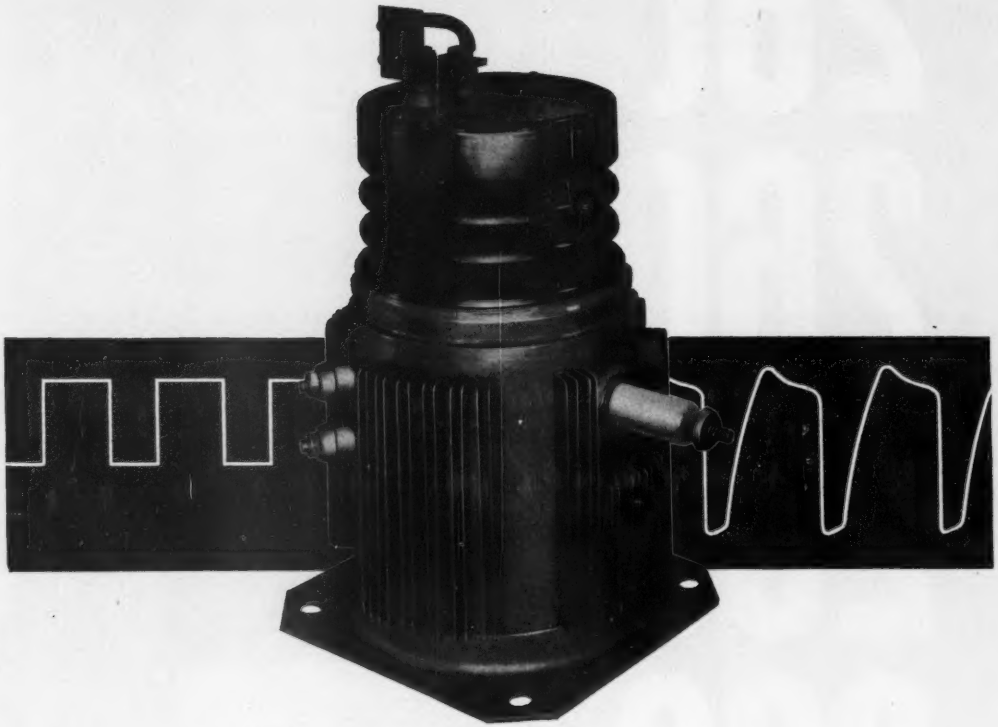
Pitch pipes such as are used to tune musical instruments were tested but proved unsatisfactory since they are vibrating reed devices with output rich in harmonics. The design informally chosen was of the pencil type and is shown in the photograph.

Four of these whistles are carried in a special pocket on each mobile unit or may be carried by the mobile operator. On desiring to make a call, the operator merely pushes the talk button on the micro-

260
260
260
260
260
260
260
260

The Simpson volt-ohm-milliammeter that outsells all others combined.

RTON BROWNE ADVERTISING



To tailor a wave more accurately...

It's a recognized principle that the smaller, more compact the pulse transformer, the more acceptable will be the shape of the output wave. That's where Westinghouse transformer engineering can offer greater advantages to the designer of electronic circuits.

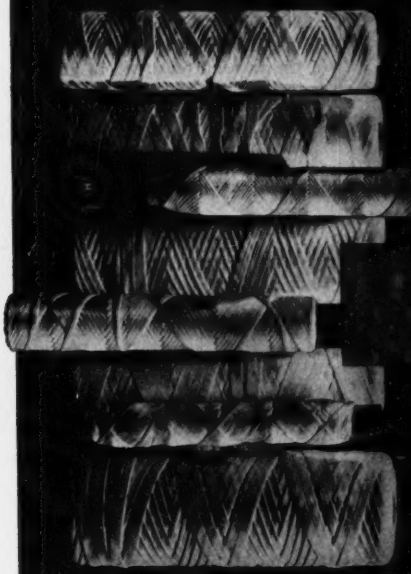
In pulse transformers like the one above, for example, Westinghouse is able to produce a smaller, lighter, better performing transformer by using a two-piece HIPERSIL® type C core wound from one mil thick material. Insulation applied depends upon actual requirements . . . for instance, Fosterite® insulation on open-type transformers for adverse atmospheric conditions; silicone oil for high-temperature applications. But with an initial advantage on core size, and corresponding reduction in coils, the compactness of Westinghouse Pulse Transformers assures better wave shape, plus saving in both size and weight.

If size, weight, performance or quantity production have any bearing on your transformer problem call your Westinghouse representative. For many applications, standardized designs are available at substantial savings. Westinghouse Electric Corporation, Specialty Transformer Department, Sharon, Pa. J-70611

YOU CAN BE SURE... IF IT'S Westinghouse

TRANSFORMERS

MITCHELL-RAND



features

MIRAGLAS*

SLEEVINGS

· non-fraying · non organic · flexibility

· high heat resistant · natural or colored

· single or double wall · high dielectric

· will not fog, smoke, stiffen, crack or corrode

*Woven of fiberglas

HYGRADE THERMOFLEX SLEEVINGS

of continuous filament fiberglas yarn, are most efficient for insulation requirements that demand a non-fraying sleeving with excessive heat resistance, high tensile and dielectric strength and flexibility. HYGRADE THERMOFLEX SLEEVINGS also resist rot, excessive heat, moisture, overloading, acid and dirt. They are available in the six grades:

THERMOFLEX 1200 (Natural) and THERMOFLEX COLORED

. . . are unaffected by temperatures to the melting point of glass and are recommended for applications where the presence of organic material is objectionable. The colors will fade or bake out at temperatures of 400° F. and higher.

ALL SIZES: .020" to 1.036" inside diameter

THERMOFLEX 1200 DBLE-WALL and COLORED THERMOFLEX DBLE-WALL

. . . are concentric sleevings braided one upon the other to increase the wall thickness where additional space factor and higher dielectric strength are required.

THERMOFLEX H. W. 1200 and COLORED THERMOFLEX H. W.

. . . are single braided, heavy wall sleevings. Their characteristics are similar to the DBLE-WALL types except that they are coarser in appearance and lower in price. They provide a mechanically strong sleeving for applications where the Underwriters' Laboratories specify a 1/32" wall sleeving.

ALL COLORS: Red, White, Blue, Yellow and Green

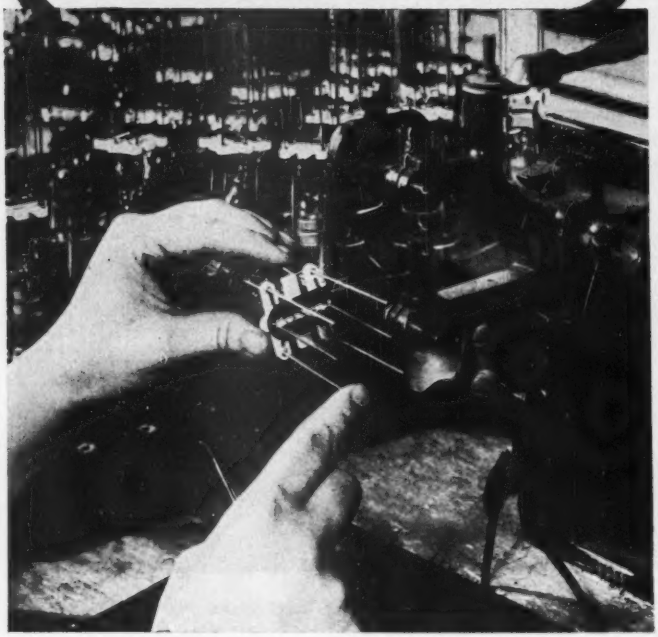
Write to MITCHELL-RAND for free samples and descriptive data.

M-R Electrical Insulation Headquarters

A PARTIAL LIST OF M-R PRODUCTS: FIBERGLAS VARNISHED TUBING, TAPE AND CLOTH • INSULATING PAPERS AND TWINES • CABLE FILLING AND POTHEAD COMPOUNDS • FRICTION TAPE AND SPLICE • TRANSFORMER COMPOUNDS • FIBERGLAS SATURATED SLEEVING • ASBESTOS SLEEVING AND TAPE • VARNISHED CAMBRIC CLOTH AND TAPE • MICA PLATE, TAPE, PAPER, CLOTH, TUBING • FIBERGLAS BRAIDED SLEEVING • COTTON TAPES, WEBBINGS AND SLEEVINGS • IMPREGNATED VARNISH TUBING • INSULATING VARNISHES OF ALL TYPES • EXTRUDED PLASTIC TUBING

TAYLOR TUBES

. . . "First Choice" for Technical Excellence!



There was an unmistakable pride of craftsmanship that characterized the first Taylor Tube built many years ago. Since then, hundreds of thousands of tubes bearing the Taylor mark have enjoyed a special admiration for their uniform ability to do every job better than expected. Today, "TQS", the *Taylor Quality Standard* is known and respected the world over. Taylor Tubes can do better for you.

★ TRANSMITTING ★ INDUSTRIAL

★ RECTIFIER ★ ELECTRONIC

As always, Taylor is producing tubes of superior quality and outstanding performance. The Taylor Representative nearest you is ready and willing to discuss your particular requirements. Call on him for information any time.

Taylor HEAVY CUSTOM BUILT DUTY Tubes

TAYLOR TUBES INC., 2312-18 WABANSIA AVE., CHICAGO 47, ILL.

Export: Royal National Company
75 West St., New York 6, N.Y.

Cable Address:
NATVARNCO, NEW YORK

phone and blows the proper whistle. The proper distance the whistle is held from the microphone was found to be about 6 inches. If the whistle is too close, distortions due to modulation limiting employed in the transmitters tend to give a distorted tone, and breath noise is introduced. At great distances the level is reduced. Frequency stability of the whistle was held to an overall tolerance of 20 cycles.

This design has performed very well and has been in service about two years. Operation is reliable down to signal-to-noise ratios of 10 db and no report has been made of false operation.

The author wishes to acknowledge the contributions of Earl Dreyer and James Allen of Missouri Public Service Company for the suggestion of the use of mouth-operated whistles and assistance during the many field tests. Dick and Ray Gredell of Radio Industries Inc. are responsible for the mechanical design of the whistle.

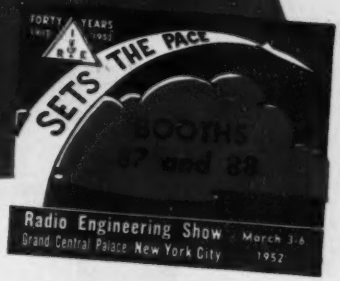
Voltage Regulator for Telescribers

BY EDWARD F. CAHOON
Chief Engineer
Telautograph Corp.
New York, N. Y.

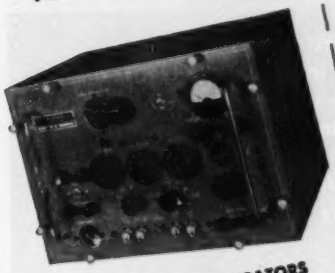
THE TELESCRIBER is an instrument which electrically transmits handwritten messages or graphic characters over wire. It consists of two basic units; a transmitter and a receiver. The telescriber transceiver, Fig. 1, is a unit containing both a transmitter and receiver. The telescriber receiver alone, Fig. 2, is for reception of messages only,

FIG. 1—Transceiver unit containing both a transmitter and receiver

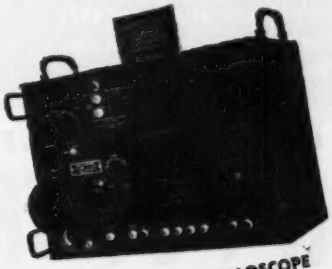
See these at the Show



PRECISION UHF WAVEMETERS



UHF SIGNAL GENERATORS



WIDE BAND OSCILLOSCOPE

Remember...

to pay us a visit at the Show and inspect, at first hand, recent LAVOIE projects, including the new developments in UHF precision test equipment, signal generators and communication systems.

All exhibits are LAVOIE produced in our own complete plant where up-to-the-minute shop techniques are unique—unsurpassed for UHF production. See for yourself what LAVOIE engineering skill and versatility have accomplished in streamlined, efficient equipment with emphasis on economy.

If you can't attend, we'll be glad to send full details on the LAVOIE exhibits or on any of the LAVOIE products listed below. A Facilities Report is also available if requested on your letterhead.

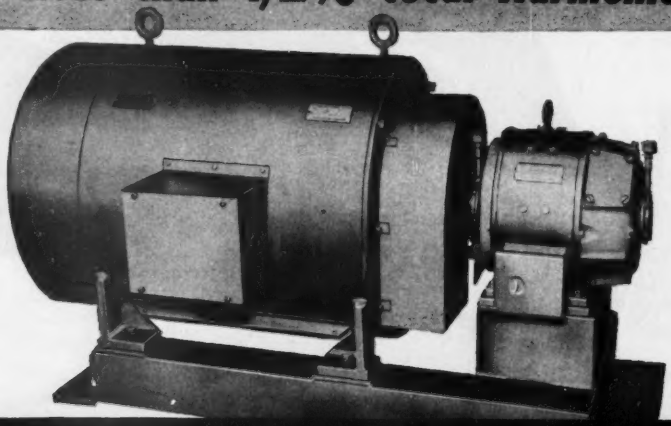
Lavoie Laboratories, Inc.

RADIO ENGINEERS AND MANUFACTURERS
MORGANVILLE, N. J.

Lavoie Products Include:

- Frequency Meters
- Frequency Standards
- Oscilloscopes
- Communication Systems
- Microwave Navigational Aids
- Radar Receivers
- Signal Generators
- C. I. Meters
- Pulse Generators
- Fixed Frequency Receivers

Do You Have Use For Practically Pure 400 CYCLE POWER *Less than 1/2% total Harmonics?*



★ For use in Laboratory and Production testing of high performance electronic equipment Bogue has developed a line of single and three phase 400 Cycle Synchronous Motor-Generator Sets ranging from 3 to 100 KW with total harmonic content less than 1/2% This extreme quality in wave form is secured thru precision design, careful selection of material and quality control in manufacture.

Special units with less than 1/10% total harmonics available.

These sets can also be furnished with magnetic amplifier static voltage regulators when the utmost in reliability and constancy in voltage regulation is required. Output frequency is exactly 400 cycles at any load—no load to full load!

If you are interested in this type power, Bogue engineers will be glad to furnish oscillograms and wave analyses of typical sets built for this requirement. You can always depend on . . .

QUALITY MAGNETIC AMPLIFIER CONTROLLED

BOGUE PRECISION POWER

BOGUE ELECTRIC MANUFACTURING COMPANY

Where Precision Coordinated Design... Counts!

50 IOWA AVENUE • PATERSON 3, NEW JERSEY

SINCE 1892 SPECIALISTS IN FINE MOTORS & GENERATORS — Bogue

MAGNETIC AMPLIFIERS • MAGNETIC CONTROLLERS • AC & DC MOTORS
AC & DC GENERATORS • VOLTAGE & SPEED REGULATORS • SWITCHBOARDS

quality magnets from start to finish

VISIT OUR BOOTH #504
I.R.E. SHOW
GRAND CENTRAL PALACE
N. Y. C. MARCH 3-6, 1952

From the first engineering drawing to the final inspection and shipping, Crucible Permanent Alnico Magnets receive the same careful attention and workmanship that is found in all Crucible specialty steels. Rigid quality control at every step in the production of Crucible Alnico . . . with a keen devotion to detail . . . is the reason that users of Crucible Permanent Alnico Magnets have found that from Crucible they get a better magnet with *higher gap flux per unit weight.*

Crucible Alnico Magnets are serving successfully in thousands of varied applications. The experience of Crucible's alert staff of metallurgists and engineers is freely available to you. Take advantage of Crucible's half century of specialty steel leadership. When you think of permanent magnets . . . call Crucible. CRUCIBLE STEEL COMPANY OF AMERICA, General Sales Offices, Oliver Building, Pittsburgh, Pa.

CRUCIBLE

52 years of Fine steelmaking

first name in special purpose steels

PERMANENT ALNICO MAGNETS

STAINLESS • REX HIGH SPEED • TOOL • ALLOY • MACHINERY • SPECIAL PURPOSE STEELS

● Use Electro Custom Processed Varnished Insulation to INCREASE LIFE EXPECTANCY and to *insure* the *safe, successful operation* of *electrical equipment.*

Selecting dependable insulation need not present any problem to design, insulation and maintenance engineers if they specify ELECTRO. Our method of processing produces varnished insulation with the ESSENTIAL SAFETY FACTORS.

You may buy with confidence when you buy these

ELECTRO

TECHNICAL PRODUCTS

Silicone Varnished Fiberglas*
Quin-Glas Hi-Temperature Insulation
Varnished Fiberglas* Cloth
Electro "300" Combination Slot Insulation
Treated Asbestos Cloth & Paper
Flexible Varnished Cambric Tape
Varnished Condenser Paper
Varnished Silk and Rayon
Cable Wrapping Tapes

We invite you to use our Special Service facilities if you need varnished insulation to meet specific requirements. Write or phone Department E-1 for technical data and samples.

ELECTRO-TECHNICAL PRODUCTS
DIVISION OF SUN CHEMICAL CORPORATION
NUTLEY 10, NEW JERSEY

*T. M. Reg. U. S. Pat. Off. by Owens Corning Fiberglas Corp.

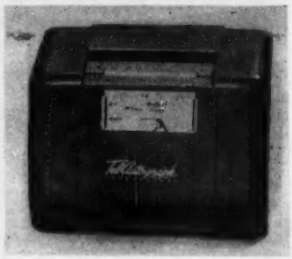


FIG. 2—Receiver unit

no transmission is possible.

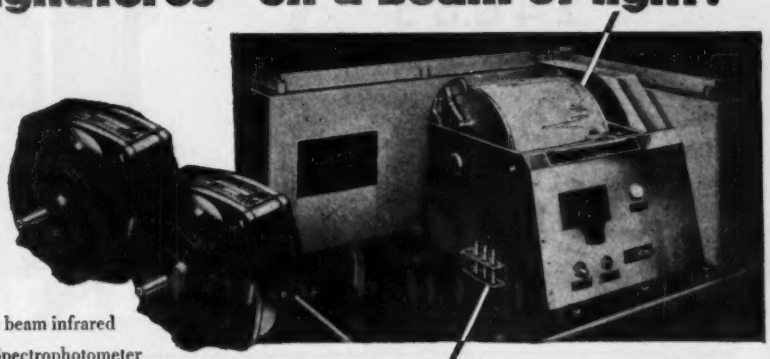
The transmitter converts the position of the manually operated writing stylus into two electrical quantities. This is accomplished by attaching a linkage system to the stylus. In amplitude-controlled models, the change of stylus position causes the linkage system to rotate potentiometer contacting members. There is a fixed voltage supplied to the potentiometers and for each position of the stylus two definite potentials are developed at the transmitter.

The receiver converts electrical information received from the transmitter into a position of the writing pen. This is accomplished by two pen-motors which are attached to a linkage system which is identical to that in the transmitter. The pen-motor, Fig. 3, is similar to a d-c voltmeter movement with a moving coil in a fixed magnetic field. The field is supplied by a permanent magnet. The angular displacement of this unit is essentially linear with respect to current through its moving coil.

In the latest Telescriber, power for moving the pen at the receiver is supplied from the transmitter. The writing circuits of this instrument are controlled by direct current. However, alternating current is its prime source of power. It is necessary to rectify, therefore, in order to obtain the direct current necessary for operation of these circuits. A dry-disc rectifier located in the terminating box is employed for this rectification.

This communication instrument, as has been described is an amplitude-controlled device. This means that the magnitude of the a-c supply (as well as the stylus position) determines the pen position at the

Holtzer-Cabot motors help the Spectrophotometer record "signatures" on a beam of light!



The double beam infrared recording Spectrophotometer developed and manufactured by Baird Associates of Cambridge, Mass., is an ingenious instrument which has proven itself invaluable in quickly and surely identifying and defining complex chemical compositions.

The Spectrophotometer analyzes organic samples by passing an infrared beam through them. The resulting vibration and energy absorption of the sample's molecules form a pattern on the Spectrophotometer's recording drum chart. Comparison of the sample's recorded characteristics with those of known elements reveals the sample's identity and composition.

Rigid specifications were laid down for the motors to operate the variable speed drive used in the Spectrophotometer. Some of the requirements:

- two winding, two speed
- synchronous operation at one speed
- smooth transition between speeds
- all speeds must be reversible
- low vibration and magnetic leakage fields
- small size—low power
- completed design must be applicable to *all* previous models

Holtzer-Cabot engineers, working closely with Baird Associates, developed two different adaptations of the H-C R-25, which met specifications perfectly. These motors are now standard components of the Spectrophotometer and are giving satisfactory, dependable service.

This is but another example of Holtzer-Cabot's ability to meet the most exacting specifications in small-motor applications. Holtzer-Cabot motors range from 1/2000 up through 1½ H.P., from 24,000 RPM to 1 revolution per day!

HOLTZER-CABOT

DIVISION OF NATIONAL PNEUMATIC CO., INC.

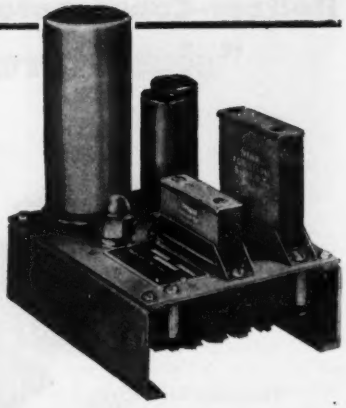
BOSTON 19, MASSACHUSETTS

"builders of fine electric motors for three quarters of a century"

Photographs through courtesy of Baird Associates, Cambridge, Mass.

40.109
240.65
1174.6
20000.
– OR ANY OTHER

precision FREQUENCY



FROM 40 TO 20,000 CYCLES

CONSERVATIVE ACCURACY UNDER USUAL CONDITIONS

1 PART IN 100,000—(.001%)

CALIBRATED AGAINST A STANDARD ACCURATE TO 1 PART IN 10-MILLION

The basic unit of this frequency standard is an electronically driven fork,—temperature compensated and hermetically sealed against changes of humidity and barometric pressure. Through its use, any frequency or multi-frequencies between 40 and 20,000, fractional or otherwise, are obtainable.

Have you a need for any specific number of cycles in precision frequencies?

Can a source of such frequency solve your design problem or increase its factor of safety?

Have you a system that requires great accuracy, stability and dependability?

The frequencies shown at the top of the page are but a few among hundreds furnished for precision application in industries, laboratories and Government departments.

OUR ENGINEERS ARE AVAILABLE TO COOPERATE ON ANY PROBLEM

American Time Products, Inc.

580 Fifth Avenue *New York 19, N.Y.*

MANUFACTURING UNDER PATENTS OF WESTERN ELECTRIC CO.

Only

ELECTRO TEC

slip ring assemblies

AND COMMUTATORS

EXCLUSIVE* ELECTRO TEC TECHNIQUES

insure closer tolerances, absolute uniformity, and the ultimate in miniaturization

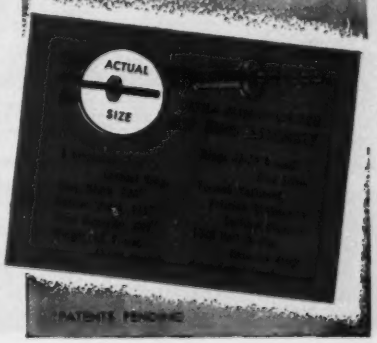
Electro Tec units are the product of an exclusive manufacturing technique that results in accuracy unattainable by conventional fabricating methods. In this process a plastic is moulded around the wire leads. Accurate machining reduces this blank to the proper shape, complete with grooves. Hard silver is deposited into the grooves by electroplating to produce the required rings. Final machining insures concentricity and dimensional accuracy. The result is one-piece, unitized construction with conducting rings of 60 to 70 Brinell hardness.

Diameters of these assemblies range from .045" to 24" cylindrical or flat. Cross-sections may range from .005" to .060" or more. Rings are polished to a jewel-like finish and can be held to 4 micro-inches or better. Even the smallest sizes withstand a 1000 V.A.C. breakdown test. Most types easily withstand rotational speeds up to 12000 rpm.

ELECTRO TEC Assemblies are Specified by the Nation's Leading Precision Instrument and Equipment Manufacturers for Proven Greater Dependability, Longer Life, Smoother Functioning.

The uniformly superior performance of Electro Tec slip ring and commutator assemblies in thousands of industrial and governmental applications has resulted in wide adoption of these component units by most leading manufacturers of precision instruments and equipment. Although these products provide improved performance and extra dependability, prices are strictly competitive. Write today for fully illustrated literature.

- ONE PIECE, UNITIZED CONSTRUCTION
- ABSOLUTE MINIMUM TORQUE FRICTION
- DIAMETERS FROM .045" TO 24.0"
- MINIMUM 1000 V.A.C. HI-POT INTER-CIRCUIT
- UNIFORMLY HARD SILVER RINGS PLATED INTO GROOVES ON PRECISION MACHINED ONE PIECE PLASTIC FORM
- SPECIAL SURFACE DEPOSITS PREVENT TARNISH, MINIMIZE FRICTION, BRUSH NOISE AND PRACTICALLY ELIMINATE WEAR



ELECTRO TEC CORPORATION

SO. HACKENSACK NEW JERSEY

PRODUCTS OF PRECISION CRAFTSMANSHIP BY A NEW AND REVOLUTIONARY PROCESS

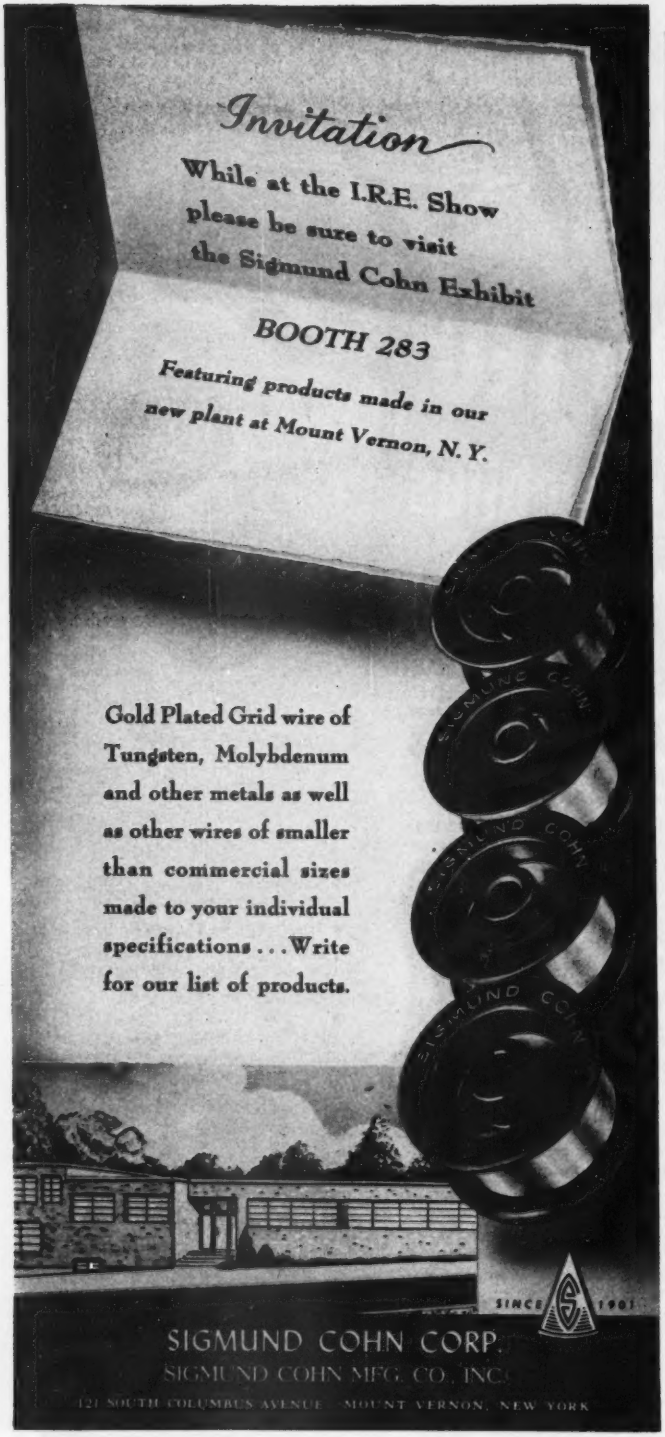

Invitation
While at the I.R.E. Show
please be sure to visit
the Sigmund Cohn Exhibit
BOOTH 283
Featuring products made in our
new plant at Mount Vernon, N. Y.
Gold Plated Grid wire of
Tungsten, Molybdenum
and other metals as well
as other wires of smaller
than commercial sizes
made to your individual
specifications . . . Write
for our list of products.
SINCE 1901
SIGMUND COHN CORP.
SIGMUND COHN MFG. CO., INC.
121 SOUTH COLUMBUS AVENUE · MOUNT VERNON, NEW YORK

FIG. 3—The pen motor. Permanent magnet (1), moving coil (2), rotary-motion translator (3), linkage lever (4) and magnetic field structure (5)

receiver. As the instrument has a high speed of response, any sudden changes in the power supply will result in distortion of the character being recorded. A voltage kick might make a 9 of an 0 or a 6 of a 1, etc., therefore voltage control is a vital consideration in achieving high-fidelity message reproduction. In order to assure this, an electronic voltage regulator is used.

The regulated voltage supply is used only for writing circuits. A rectified, but nonregulated, source of power is employed for some of the auxiliary circuits. This rectifier is located in the terminal box also.

The circuit diagram of this regulator is shown in Fig. 4, also shown is the rectifier and filter. It can be seen that it is a conventional circuit employing 6AS7's for handling the power and a 12AX7 for controlling the 6AS7's. A VR75 is used to obtain the reference voltage. A second VR75 is used in the voltage-divider circuit to the grid of the 12AX7 to increase the sensitivity. A potentiometer is employed to control the output voltage from the regulator.

The regulator has an output volt-

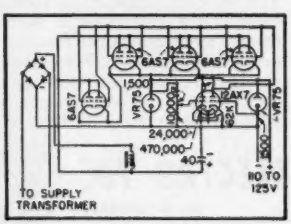


FIG. 4—Schematic of voltage regulator

Another important development from
world's largest manufacturer of
precision potentiometers...

Helipot

TINY in size—

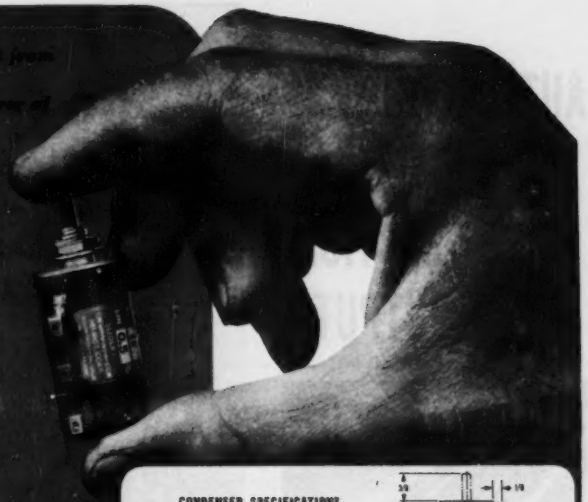
the diameter of a penny!

BIG in performance—

12 times the resolution
of a conventional "pot."

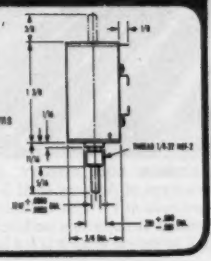
THE MODEL AJ

Helipot



CONDENSED SPECIFICATIONS

Number of turns	10
Power rating	2 watts
Coil length	18"
Mechanical rotation	3600° + 12° − 0°
Electrical rotation	3600° + 12° − 0°
Resistance ranges	100 ohms to 50,000 ohms
Resistance tolerance	± 5.0%
Linearity tolerances:	
All values	± 5% (standard)
5000 ohms and above	± .1%
Below 5000 ohms	± .25%
Starting torque	0.75 oz. in.
Net weight	1.0 oz.



Miniaturization, weight reduction and circuit simplification are key design objectives in all airborne and many other electronics applications for precision potentiometers. Helipot's new Model AJ meets these needs with a compact potentiometer having over 12 times the resolution of conventional potentiometers of the same diameter . . .

- **SIZE AND WEIGHT: The AJ is only ¾" in diameter (small as a penny)—1⅝" long—weighs 1.0 oz. It requires only a minimum of valuable panel space!**
- **PRECISION, WITH CIRCUIT SIMPLICITY: On many applications the AJ replaces two conventional potentiometers, providing *both* wide range and fine adjustment in one unit. Its 18" slide wire gives a resolution of 1/3000 in a 100 ohm unit—1/6550 in a 50,000 ohm unit!**
- **RELIABILITY: The AJ is rugged and simple, is built to close tolerances with careful quality control. Its performance and reliability reflect the usual high standards of Helipot quality!**

MANY IMPORTANT CONSTRUCTION FEATURES: If you have a potentiometer application requiring light weight, unusual compactness, high accuracy and resolution, be sure to get the complete information on AJ advantages . . .

Here is a "pot" with bearings at *each* end of the shaft to assure precise alignment and linearity at all times. In addition, each bearing is *dust-sealed* for long life and is mounted in a *one-piece* lid and bearing design for exact concentricity.

Either single or double shaft extensions can be provided to meet individual needs —also, special shaft lengths, flats, screwdriver slots, etc.

Tap connections can be provided at virtually *any* desired point on the resistance element by means of a unique Helipot welding technique which connects the terminal to only ONE turn of the resistance winding. This important Helipot development eliminates "shorted section" problems!

BUILT TO HELIPOT STANDARDS

Helipot—world's largest manufacturer of precision potentiometers—has built an enviable reputation for highest standards in all its products, and the Model AJ is no exception.

The resistance elements themselves are made of precision-drawn alloys, accurately wound by special machines on a copper core that assures rapid dissipation of heat.

Each coil is individually tested to rigid standards, then is permanently anchored in grooves that are precision-machined into the case. Slider contacts are of long-lived Paliney alloy for low contact resistance and low thermal e.m.f. . . . and precious-metal contact rings are used to minimize resistance and electrical noise. All terminals are silver plated and insulated from ground to pass 1,000 volt breakdown test.

LONG LIFE: Although Unusually compact, the AJ is built throughout for rugged service. Potentiometer life varies with each application, of course, depending upon speed of rotation, temperature, atmospheric dust, etc. But laboratory tests show that, under proper conditions, the AJ has a life expectancy in excess of one million cycles!

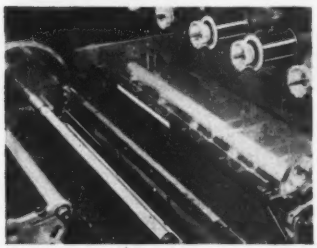
Helipot representatives in all major cities will gladly supply complete details on the AJ—or write direct!

THE Helipot CORPORATION

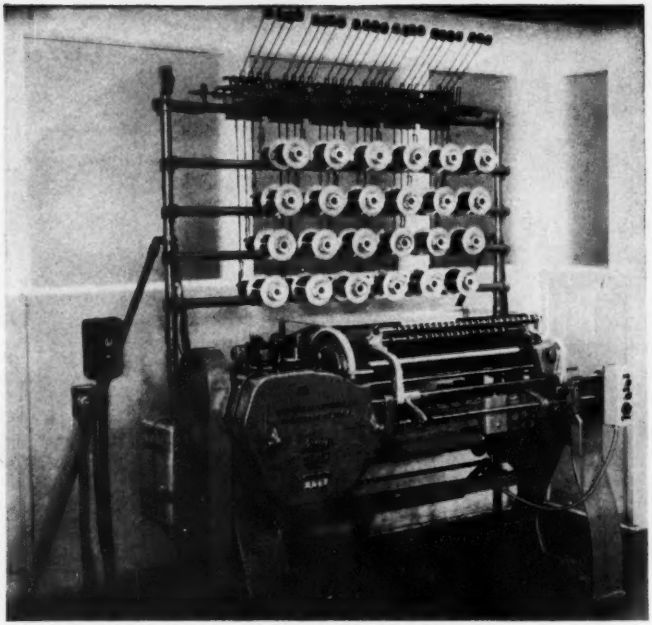
South Pasadena 2, California

Field Offices: **Boston, New York, Philadelphia, Rochester, Cleveland, Detroit, Chicago, St. Louis, Los Angeles and Fort Myers, Florida.** ***Export Agents:*** **Fratham Co., New York 18, New York.**

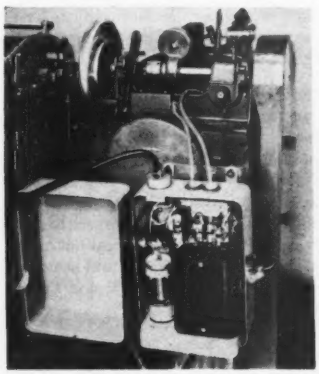
AUTOMATIC FEED BOOSTS PAPER-SECTION COIL OUTPUT



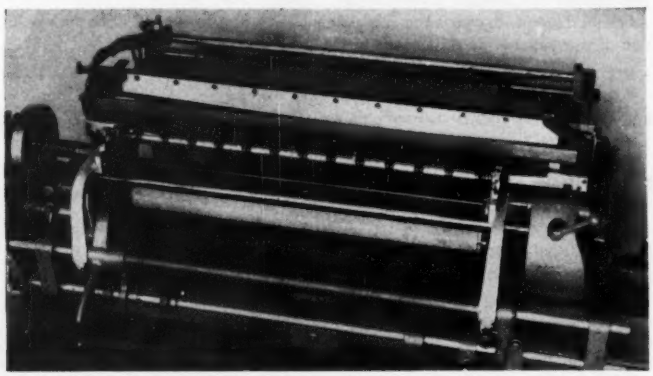
MAXIMUM COIL DENSITY An entirely new type of delivery shelf is used to insure coils of extreme accuracy and high density. It imparts a uniform backward pull to the paper as it is fed into the coil.



25 INSERTS A MINUTE Single or laminated insulating sheets, either paper or acetate, are fed into the Leesona No. 107 Coil Winder at rates as high as 25 per minute. Thus, on a coil containing 100 wire turns per layer, the machine can be run at speeds as high as 2500 rpm.



SLOW, CUSHIONED AUTOMATIC START Electronic speed-control automatically and smoothly accelerates the winding arbor to required speed and maintains it. No "jockeying" needed by operator. Wire breakage is minimized, tension is uniform.

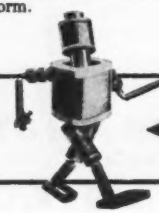


EASY MANUAL OPERATIONS Photo shows coil arbor in position for quick transfer. Wire turn counter can be reset quickly. No cam transfers are required when changing wire layer length, wire spools are easily changed.

Write for GMCW-15

UNIVERSAL WINDING COMPANY

P. O. Box 1605, Providence 1, R. I.



LEESONA

For winding coils in quantity accurately . . . automatically use Universal Winding Machines

238.1.3

klystrons

AT WORK IN THE LABORATORY

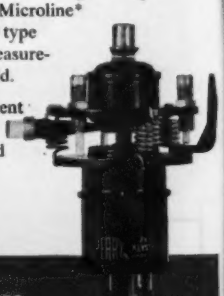
Sperry Klystron tubes are doing heavy duty in the labs where a practical source of continuous microwave energy is needed for general test and measuring work. A complete line of 2K tubes is available for bench oscillator use from 2660 to 10,300 mc.

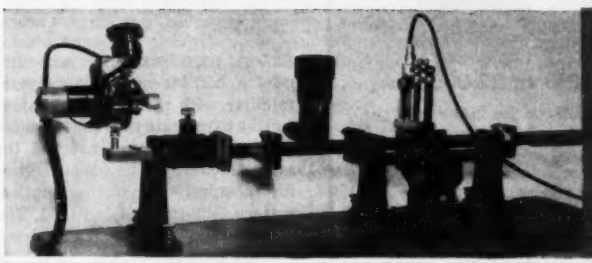
Stemming from its sponsorship of the development of the klystron in 1939, Sperry has had many years' experience in the manufacture of these tubes. Besides the 2K-series for laboratory use, other Sperry Klystrons include transmitting tubes for microwave relays, radars (both pulsed and cw), radar beacons, aeronautical navigation (DME and ILS), and radio communication systems. Other Sperry Klystrons are used as local oscillators in radar and microwave communication receivers. Klystron multiplier tubes are used in frequency standards and for other applications where crystal control at microwave frequencies is desired.

Sperry's pioneering in microwave measuring techniques has resulted in a complete line of Microline* instruments which includes every type of device essential to precision measurement, in the entire microwave field.

Our Special Electronics Department will be happy to supply you with complete details on Klystrons and Microline equipment.

*T. M. REG. U. S. PAT. OFF.





SPERRY 2K SERIES

	TUNING RANGE	POWER OUTPUT
2K 41 (WITH TUNER)	2660 -3310 mc	250 mw
2K 42	3300 -4200 mc	250 mw
2K 43	4200 -5700 mc	250 mw
2K 44	5700 -7500 mc	250 mw
2K 39	7500 -10,300 mc	250 mw

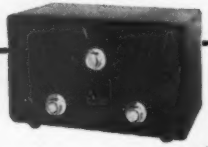
VISIT SPERRY BOOTHS 57-58-59 AT THE RADIO ENGINEERING SHOW, GRAND CENTRAL PALACE, MARCH 3-6

SPERRY GYROSCOPE COMPANY
DIVISION OF THE SPERRY CORPORATION

GREAT NECK, NEW YORK · CLEVELAND · NEW ORLEANS · BROOKLYN · LOS ANGELES · SAN FRANCISCO · SEATTLE
IN CANADA — SPERRY GYROSCOPE COMPANY OF CANADA, LIMITED, MONTREAL, QUEBEC

4 NEW OSCILLATORS

.009 to 520,000 cps.



MODEL 400-A

.009 to 1,100 cps.

True sine wave oscillator circuit. No tuning or switching transients.

Price $350.00

MODEL 420-A

.35 to 52,000 cps.

Audio and Sub-Audio ranges. Fast AVC action.

Price $290.00

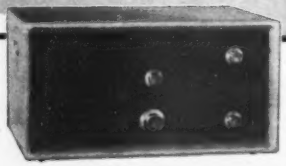
EACH MODEL FEATURES

● Both sine and square waves, simultaneously. ● Good amplitude constancy, ±1 db over the entire frequency range. ● Low distortion, less than 1%. ● Accurate calibration, better than ±2%. ● Single scale logarithmic dial with vernier tuning control. ● Sine Wave Output, 30 volts peak to peak. ● Low Hum and d-c component, less than 0.1% of output at any level. ● Calibrated logarithmic output level control. ● Input power, 45 watts. ● Small size, overall 12" x 7" x 8".

MODEL 430-A

4.5 to 520,000 cps.

● Good Amplitude constancy, ±1 db over the entire frequency range. ● Low distortion, less than 1% at any frequency. ● Accurate calibration, ±1.5%. ● Five decade Bands. ● Single scale logarithmic dial. ● Calibrated logarithmic output level control. ● Fast AVC action. ● Small size, overall 12" x 7" x 8". ● Price $145.00.



MODEL 410-A

.018 to 22,000 cps.

● Both sine and square waves, simultaneously. ● Excellent amplitude constancy, ±0.25 db over the entire frequency range. ● Extremely low distortion, less than 0.25% at any frequency. ● Fast recovery from transients. ● Accurate calibration ±1.5%. ● Single scale logarithmic dial. ● Calibrated output attenuator switch. ● Constant impedance "T" pad output control. ● Vernier tuning control. ● Price $950.00

VISIT US AT THE I.R.E. SHOW, MARCH 3-6, BOOTH 440

KROHN-HITE INSTRUMENT Company

K-H

[illegible] MASSACHUSETTS AVENUE, CAMBRIDGE 39, MASS.

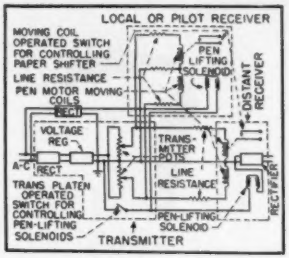


FIG. 5—Fundamental circuits of telescriber

age of 120 volts and is made in two capacities. One model supplies power for writing between a transceiver and a receiver. The other model is used when writing between a transceiver and three receivers simultaneously or, in a different transmitter arrangement, between a transceiver and seven receivers. The former employs two 6AS7's and the latter four 6AS7's. The control circuit is the same for both regulators. The output regulation is within one volt between half-load and full-load. Transient response is sufficiently fast so that a change of ten volts in the primary supply does not affect the receiver pen position.

Figure 5 shows the fundamental circuit of the telescriber.

Accurate Phase Difference by Lissajous Figures

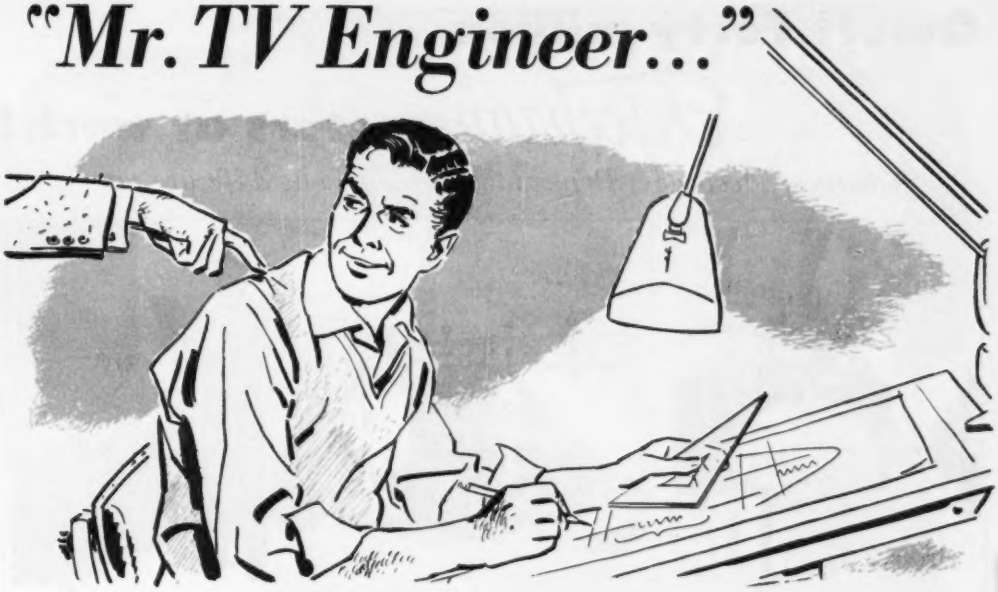
By John L. Glaser
Department of Electrical Engineering
Washington University
St. Louis, Mo.

Practically everyone who has used a cathode-ray oscilloscope is familiar with the use of Lissajous figures to indicate the relative phase of two sinusoidal voltages of the same frequency. The usual method for interpretation of the elliptical pattern is illustrated in Fig. 1. The phase difference θ between the horizontal and vertical input signals is given by the relation

$$\sin\theta = \pm\frac{A}{B} \qquad (1)$$

The accuracy with which θ can be measured depends, of course, on the accuracy with which the ratio A/B can be measured. It is doubt-

"Mr. TV Engineer..."



For superior arc resistance, dimensional stability—plus high heat resistance, INSIST on PLASKON ALKYD

If you want benefits like these, then look into Plaskon Alkyd. For here is a molding compound that is made-to-order for television and other electronic insulating parts!

Yes, *made-to-order* . . . for Plaskon Alkyd has exceptional dimensional stability with no after-shrinkage. This means that the very close tolerances so necessary to precision television assemblies can be met and held. Because of high heat resistance (up to 400°F.), Plaskon Alkyd does not break down, even under short-time contact with molten solder when connections are made.

In addition, Plaskon Alkyd offers a combination of superior arc resistance, high dielectric strength, excellent resistivity that makes it *outstanding* as an electrical insulating material. And it can be molded faster and at lower pressures, allowing increased production and greater savings. *In fact, production increases up to 292% have been realized.*

Before you redesign, look into the advantages Plaskon Alkyd can offer. Write today for full information on television and electronic uses.

TELEVISION TUBE BRACKETS

TELEVISION TUBE BASES

TELEVISION CONDENSERS

TELEVISION TUNERS

Plaskon's Molding Shop On Wheels

Fully equipped with molding presses and complete testing equipment. Plaskon technicians will demonstrate right at your door the superiority of parts molded from Plaskon Alkyd over parts you may be using now. Inquire today.

INSIST ON

PLASKON.

ALKYD

FOR SUPERIOR ELECTRICAL PARTS

PLASKON DIVISION

Libbey • Owens • Ford Glass Company

Toledo 6, Ohio

In Canada:

Canadian Industries, Ltd. • Montreal, P.Q.

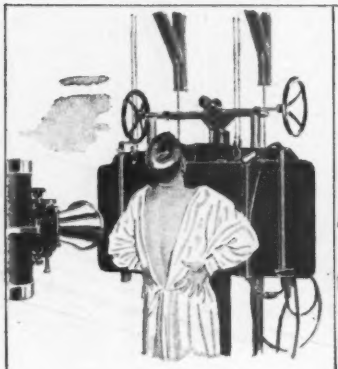
Branch Offices:

Boston • Chicago • Los Angeles • New York

Manufacturers of Molding Compounds, Resin Glues, Coating Resins

Quiet! Forty million Telechron® motors at work!

wherever Accuracy, Dependability and Long Life are vital



In controlling clinical tests, split-second accuracy is required.

Signaling devices demand dependability. Failure can mean disaster.

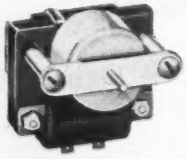
In applications like Demand Meters, a motor must have long life.

Today, in instruments and other devices, more than forty million Telechron synchronous motors are at work . . . quietly serving the nation's industries, laboratories and homes in a thousand different ways.

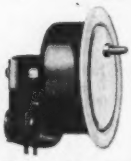
As accurate as current itself, the Telechron motor has a rotor so light that it is perfectly synchronized with AC impulses. It responds immediately and reaches full speed in a fraction of a second, giving the accuracy that is so essential to sensitive instruments.

In motion, the rotor virtually floats in its own rotating magnetic field. It's a fact that the rotor shaft bearing of a Telechron motor has never worn out as long as lubrication—which is drawn from a reservoir by capillary action—is constantly maintained. This action furnishes a continuous flow of lubricant to gears, pinions and shafts.

For complete specifications *on the full line of Telechron motors, write for booklet 1S-120. Telechron Department, General Electric Company, 43 Homer Avenue, Ashland, Mass.*



Type B3 Motor—For medium-duty switching, controlling and recording-controlling, such as time switches, business machines, time stamps, system clocks for public buildings, household door chimes and recording instruments.

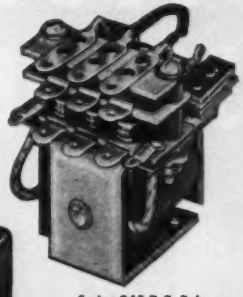


Type C5 Motor—For heavy-duty timing, switching and controlling such as traffic controls, airfield landing lights, tower clocks and instrumentation. Sturdy gear train construction.

Telechron®

Relays BY GUARDIAN GUIDE THE WAY!

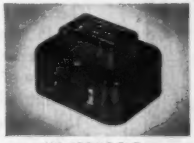
Safe, smooth, night flying of military and commercial aircraft depends largely upon efficient traffic control. Aircraft landing lights, radar and communications systems usually employ Guardian Relays for split-second response, unfailing operation and a minimum of maintenance. Again on the ground, Guardian Relays in automatic signal systems guide motor car and rail traffic with a speed and accuracy far beyond the limitations of human eyes and hands. Guardian Relays control many more applications, ship and ashore, either open type or HERMETICALLY SEALED to withstand dust, gun blast heat, fog, fungi, salt air, stratosphere cold, even concussion and bursting shells. From simple circuits to the complexities of Time Delay—Timing—Counting—Multiple Credit—Add and Subtract or Sequence operations—Guardian can solve your control problem . . . *FAST!*



Series 345 D.C. Relay

A. N. Connector, H. S. Container

AN-3320-1 D.C.



AN-3324-1 D.C.

Series 595 D.C.

Series 610 A.C.—615 D.C.

Series 695 D.C.

WRITE—WIRE—TELETYPE—PHONE NOW!

GUARDIAN ELECTRIC

1625-C W. WALNUT STREET CHICAGO 12, ILLINOIS

A COMPLETE LINE OF RELAYS SERVING AMERICAN INDUSTRY

MEET

JAN-I-225, 16E4 (Ships) and MIL-I-6181 Specifications for Radio Interference Suppression!

ACE *Pre-built* SCREEN ROOMS

Features

1. Attenuation of 100 DB and higher from 0.15 to 10,000 MC.
2. Prebuilt, immediate installation, easy to relocate or to enlarge.
3. Standard and special types and sizes to meet practically any requirement.
4. Special filter entry and door construction.
5. Special service entrance for gas, air, water, etc., when required.

Write, wire or 'phone for details

ACE ENGINEERING and MACHINE CO., Inc.

3644 N. Lawrence St., Philadelphia 40, Pa. Telephone: REgent 9-1019

See Us at the I.R.E. Show—Booths 350-352

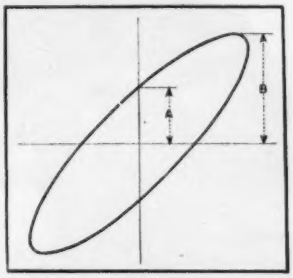


FIG. 1—Usual interpretation of Lissajous figures for measuring relative phase

ful whether the accuracy of reading this ratio is as good as ± 1 percent with most oscilloscopes. If the actual value of θ is close to ± 90 deg the effect of that great an error is appreciable. For example, if the actual phase difference is 80 deg the actual value of A/B is 0.985. With a ± 1-percent accuracy in reading this ratio, the ratio might be read to lie somewhere between 0.975 and 0.995. This range in A/B corresponds to a range in θ of 77.2 to 84.3 deg. The measured phase angle could be off by as much as 5 percent under the conditions assumed here. The effect is even worse for phase angles which are even closer to ± 90 deg.

The overall accuracy of phase-angle measurements can be improved by feeding either the horizontal or vertical input signal through a calibrated phase shifter and adjusting the phase shifter until the ellipse reduces to a single line.[1] Direct-reading phase meters have also been developed.[2,3] Unless a laboratory has frequent need for phase measurements, it is unlikely that either a calibrated phase shifter or a phase meter will be found on hand.

The utility of the oscilloscope alone in measuring phase differences can be retained over the entire range of possible angles by the somewhat different interpretation of the Lissajous figure shown in Fig. 2. For the example depicted here the gains of the oscilloscope amplifiers have been adjusted to give equal amplitudes of horizontal and vertical deflection on the screen. The ratio of dimensions C and D shown in Fig. 2 give the phase dif-

new uses for Ceramag NON-FERROUS CORES!

. . . higher temperature operation in nitrogen atmospheres

New equipment designed and sealed in nitrogen, due to high ambient temperatures imposed by miniaturization, poses a real temperature problem for permeability tuning cores as well as for I-F transformer and R-F cores. This is solved handily by Stackpole Ceramag cores thanks to the fact that they stand higher temperatures and show less drift than high-permeability powdered iron cores.

. . . low-frequency loop cores

The extremely high permeability inherent in Stackpole Ceramag ferrite cores makes them unsurpassed for exacting low-frequency loop uses.

. . . supersonic-frequency applications

Ceramag cores assure high permeability with low losses in the supersonic-frequency range.

. . . center cores for powdered iron pot cores

Used as center cores in powdered iron pot cores operating at less than 1 megacycle, Ceramag increases the L by approximately 100% and increases the Q on the order of 50%.

. . . incremental permeability applications

Because Ceramag is more easily saturated than conventional core materials, it is ideally suited for pulse generation, magnetic amplifying and incremental permeability tuning.

STACKPOLE

Electronic Components Division

STACKPOLE CARBON COMPANY • St. Marys, Pa.

For low-level d-c measurements use these new, L&N triple-purpose Amplifiers

High precision checking and calibrating under factory conditions using D-C Indicating Amplifier as null detector for accurate bridge and potentiometer circuits. Through combination of a-c amplification and balanced feedback network, zero and gain stability are designed right into instrument. Trimmer controls are eliminated.

SPECIFICATIONS

MICROVOLT UNIT No. 9835	MICRO-MICRO-AMPERE UNIT No. 9836
FULL SCALE RANGES WITH BUILT-IN 4" METERS	
0 to 50 or −25 to +25 Microvolts; scale multipliers: 1, 2, 4, 10, 20, 40	0 to 1000 or −500 to +500 Micro - Microamps; scale multipliers: 1, 2, 5, 10, 20, 50, 100, 200, 500, 1000, 2000
ACCURACY	
Of amplifier: ±0.4% of reading; Of meter: ±1%	Of amplifier: ±0.5 to 0.8%* of reading; Of meter: ±1%
ZERO OFFSET	
Max. offset: ±0.5 Microvolt	Max. offset: ±2% of scale
**SOURCE RESISTANCE*	
Up to 10,000 ohms.	0.1 megohm or more.
REPONSE TIME	
2 to 3* sec.	2 to 3* sec.
OUTPUT	
For full scale input on any range: 10 millivolts at output impedance of 500 ohms for null recorder; 1 volt for 20,000-ohm external meter.	
Front panel fits standard 19" relay rack.	
*Accuracy and Response Time depend on Source Resistance.	

Jrl. Ad EM9-51(2)

can be used as . . .

- ✓ **DIRECT-READING MICROVOLTMETER OR MICRO-MICROAMMETER**
- ✓ **RECORDER PREAMPLIFIER**
- ✓ **NULL DETECTOR**

THESE new D-C Indicating Amplifiers are the answer for all your low-level measurements with thermocouples, strain gages, bolometers—bridge and potentiometer circuits—ionization, leakage, and phototube currents—almost any measurement of extremely small direct current or voltage.

Actually 3 instruments in 1, Amplifiers can be used as:

✓ Direct-reading instruments—Scale multiplier knob lets you select the range in which you want to work.

✓ Recorder preamplifiers—with broad flexibility. One or two degrees temperature difference can be spread right across a 10" Speedomax recorder chart.

✓ Null detectors—more sensitive than most reflecting galvanometers, yet with full scale response time of only 2 to 3 seconds. Leveling is unnecessary; the instrument is not affected by vibration. At the turn of a range knob, you have available a wide choice of sensitivities. And when using non-linear response, not only does the instrument stay on scale at extreme unbalance; sensitivity increases automatically as the null point is approached.

For details, send for Folder EM9-51(1). Write our nearest office, or 4979 Stenton Ave., Phila. 44, Pa.

MEASURING INSTRUMENTS · TELEMETERS · AUTOMATIC CONTROLS · HEAT-TREATING FURNACES

LEEDS & NORTHRUP CO.

Bendix...

...is Prepared to Design Dynamotors to MIL-D-24 for Quantity Production...

• The design and manufacture of dynamotors for military service has been Red Bank's business for over ten years. The requirements of the new dynamotor specification MIL-D-24 therefore include many of the features that are incorporated in all Bendix dynamotors. When compliance with MIL-D-24 is required, Bendix engineers will work with you to design a unit exactly fitting your needs and will prepare the detailed supplementary specifications covering your model as required by MIL-D-24. Following approval and assignment of a military designation, Bendix production will be geared to your schedule. Write direct to:

Visit us in Booths 14—17 at the Radio Engineering Show March 3—6

RED BANK DIVISION OF BENDIX AVIATION CORPORATION
RED BANK, NEW JERSEY
Export Sales: Bendix International Division, 72 Fifth Avenue, New York 11, N. Y.

Bendix AVIATION CORPORATION

MILO RADIO

COMPLETE SOURCE for JAN-TYPE COMPONENT PARTS

MEET JOINT ARMY-NAVY SPECIFICATIONS !

MOST COMPLETE STOCK IN THE NATION!

UG and AN CONNECTORS
RG CABLE and WIRE
JAN CONDENSERS
JAN RESISTORS
JAN TRANSFORMERS
JAN and SPECIAL PURPOSE TUBES
JAN SWITCHES
JAN RELAYS
JAN PARTS of ALL TYPES

MILO has Everything!

MILO stocks the products of over 200 nationally-known electronic equipment manufacturers, including their complete lines of JAN parts, which meet the rigid Joint Army-Navy Specifications. No matter what your need in any electronic category, MILO has it!

IMMEDIATE DELIVERY —from STOCK!
All Types SYLVANIA SILICON CRYSTALS
GERMANIUM XTAL DIODES

Avoid production delays! We stock all standard types and sizes – for all applications.

NEW 1952 CATALOG NOW READY! Over 1100 Pages!

Purchasing Agents! Chief Engineers!

Get your FREE copy of our new 1952 catalog, listing all the latest equipment in the industry. Over 75,000 items, 7000 illustrations. An invaluable aid in your work. Write on your company letterhead, stating your official position. Address Dept. ME.

MILO offers SERVICE!
PRICES and INFORMATION ON REQUEST

- PHONE—15 TRUNK LINES
- DIRECT W.U. WIRE—MILO-WUX-N.Y.
- TELETYPE—TWX-NY1-1839

Send Today for This Valuable Book!

MILO RADIO & ELECTRONICS CORP.
200 GREENWICH STREET, NEW YORK 7, N. Y. · Tel. BEekman 3-2980
Cable Address: MILOLECTRO · The ONE Source for ALL your electronic needs

ference θ according to the relation

$$\tan \frac{\theta}{2} = \pm \frac{C}{D} \qquad (2)$$

The dimensions C and D are to be measured in the directions indicated in Fig. 2. It is assumed here that positive input voltages result in deflections upward and to the right for the respective inputs. If either (but not both) of these conditions is reversed in the oscilloscope in use, the dimensions C and D should be interchanged. For values of θ between -90 and $+90$ deg, C will be less than D. With θ between -90 and -180 deg and between $+90$ and $+180$ deg, the reverse is true.

The $\pm$ sign in Eq. 2 leaves an uncertainty as to which input is leading in phase. This uncertainty can be resolved by passing either input signal through a circuit which introduces a phase shift of known direction and noting the manner in which the pattern is changed.

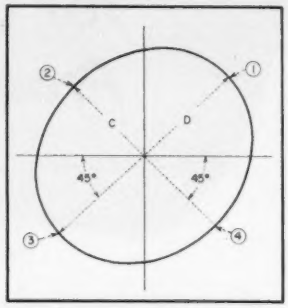


FIG. 2—Interpretation of Lissajous figures by method described

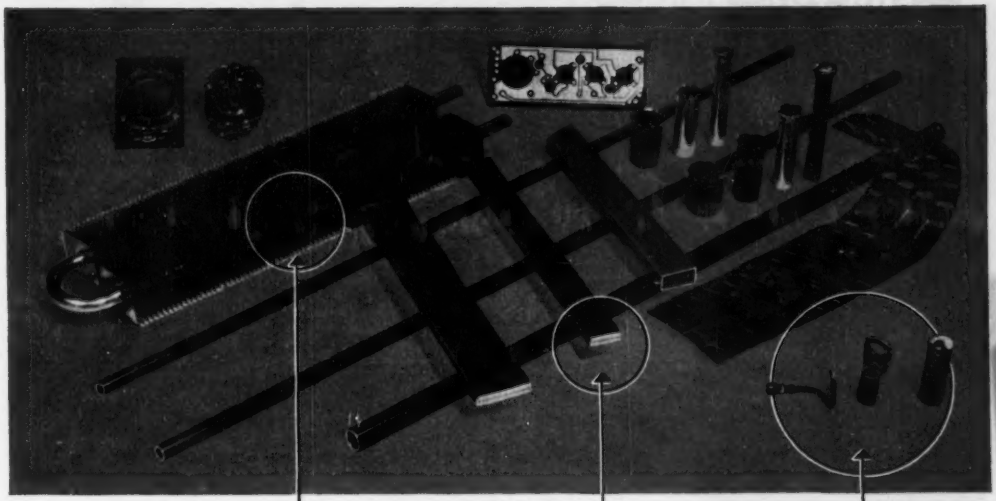
To compare the two methods discussed above, consider the example previously used but apply the interpretation illustrated by Fig. 2. A phase difference of 80 deg corresponds to a ratio C/D of 0.839. A $\pm$ 1-percent accuracy in measuring this ratio means that it might be measured to be between 0.831 and 0.847. The corresponding range in θ is from 79.5 to 80.5 deg which represents an accuracy of about $\pm$ 0.6 percent.

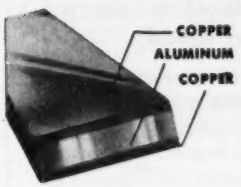
The proof of the relation given in Eq. 2 is readily obtained by considering the deflections at the times when the spot is at points 1, 2, 3 and

General Plate Alcuplate®

(COPPER-CLAD ALUMINUM)

Does The Work of Solid Copper... Helps Conserve Critical Copper





HEAT TRANSFER SECTION — Alcuplate provides ideal fin sections. The aluminum allows proper heat transfer . . . the copper gives a copper surface for soft soldering.

ALCUPLATE BUS BARS — Bus bars can be made by folding Alcuplate providing copper on all sides. Rectangular wave guide can have a thin layer of copper on the inside or outside.

ALCUPLATE TERMINALS— Small terminals and large pressure type connectors are formed from single Alcuplate. Allows joining of dissimilar metals, copper to copper and aluminum to aluminum.

General Plate Alcuplate (copper-clad aluminum) provides a practical solution for conserving or extending your copper allotment.

Made by permanently bonding a thin layer of critical copper to thicker, more readily available aluminum, Alcuplate has practically the same physical and electrical properties as copper plus the light weight of aluminum.

Alcuplate can be fabricated by stamping, drawing or forming. Its malleability permits its use in the manufacture of many parts from work-hardened rather than annealed or dead soft materials. The copper surface permits soft soldering.

Alcuplate is widely used in the electrical field for terminals, clips, bushings, shims and high frequency application such as wave guides. It may also be used for heat transfer assemblies, fin and tube type radiators, printed circuits, badges, costume jewelry, etc.

General Plate Alcuplate is available in sheet and strip clad on one or both sides, 8" wide in thicknesses ½" and under. Tubing and wire are also available in limited sizes.

Write for Technical Data Bulletin No. 702B.

GENERAL PLATE

Division of Metals & Controls Corporation

33 FOREST STREET, ATTLEBORO, MASS.

85° BELOW ZERO

would freeze an eskimo

. . . WON'T FREEZE VARGLAS SILICONE

Contains samples for you to test of the revolutionary development of Varflex laboratories . . .

500° ABOVE

would roast the devil

. . . WON'T ROAST VARGLAS SILICONE

Electrical Insulating Tubing and Sleeving lead wire and tying cord

Efficient at 500° F. or more in some applications—yet completely flexible at —85° F. Resistant to moisture and lubricating oil—flame resistant and self-extinguishing—this pioneer silicone tubing and sleeving developed by Varflex is available in various NEMA colors where required.

Varglas Silicone is a combination of *Varglas*—continuous filament Fiberglas; moisture and fungus proof; will not burn; strong and flexible at high and low temperatures; chemically inert . . . and *Silicone High Temperature Resin*—which has a natural affinity for Fiberglas; renders it abrasion-resistant, flexible and non-fraying. Normalizing process removes binder and organic inclusions from the Fiberglas; improves electrical qualities and allows uniform impregnation.

Investigate the NEW, low cost VARFLO Sleeving and Tubing if you do not have to allow for an unusually high operating temperature. Samples and prices on request. It's flexible. It takes rough handling without loss of dielectric. It won't fray out. Made with a Fiberglas braid, it won't support combustion—YET COSTS NO MORE THAN COTTON.

Clip and mail this coupon TODAY!

VARFLEX CORPORATION

308 N. Jay St. Rome, N. Y.

Please send me folder containing free samples of Varglas SILICONE products.

Name_____

Company_____

Address_____

City_____ **Zone**____ **State**_____

Varflex CORPORATION

Makers of Electrical Insulating Tubing and Sleeving

Only One Source gives you Double Duty TV!

Highest Quality Studio Programming Resources — plus

Portable Packaging for Maximum Studio-Field Flexibility!

When you invest in GPL TV *studio* equipment, you're buying *field* equipment as well. Every GPL unit provides unparalleled flexibility, light weight, easy handling, precise control. Let GPL engineer *your* station, from camera to antenna. Have *The Industry's Leading Line*—in *quality*, in *design*.

Camera Unit

Precision-built, lightweight, fast-handling. Push-button turret, remote iris control, remote focus and range selection. Easiest to service.

Camera Control Unit

Touch-identified controls. 8½" monitor tube. Split or single headphone intercom system. CRO views horizontal, vertical, and vertical sync block. Iris control.

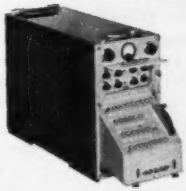
Camera Power Unit

Rugged, dependable, compact. Matched to other units in GPL chain. Standard relay panels swing out for maintenance.

Synchronizing Generator

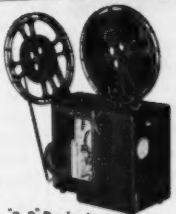
Affords maximum circuit reliability without operator adjustment. Binary counters and delay lines, stable master oscillator. Built-in power supply.

Complete TV Station Installations from Camera to Antenna



Video Switcher

Full studio flexibility anywhere. Control can view, preview, fade, dissolve, etc. Views any of 5 inputs, 2 remotes, outgoing line. Twin fade levers.

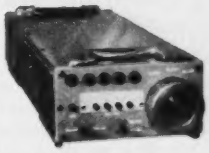


3-2 Projector

Portable sync unit. No need for special phasing facilities. Projects rear-screen or "direct in." Ideal for remote origination of film. Relieves load on Telecine.

Professional TV Projector

Highest quality 16-mm projector designed specifically for TV. Delivers 100 foot-candles to tube. Sharp, steady pictures from 4000-foot film magazine.



Remote Control Box

Provides revolutionary remote control of camera focus, lens change, pan, tilt. Styled to match other components in the GPL TV line.

See Remote Control in Action—Booth 18-20 IRE Show.

WRITE WIRE OR PHONE FOR DETAILS

General Precision Laboratory

INCORPORATED

PLEASANTVILLE NEW YORK

TV Camera Chains • TV Film Chains • TV Field and Studio Equipment • Theatre TV Equipment

Let us be your dependable production arm for

CABINETS

CHASSIS

HOUSINGS

COMPLETE ASSEMBLIES

Corry-Jamestown's three large plants can give you *prompt* delivery on cabinets, housings, chassis and complete assemblies for radar and other electronic equipment. We're ready with the latest time-saving metal fabricating equipment . . . skilled craftsmen . . . a staff of highly specialized engineers . . . and the production know-how of 30 years experience fabricating steel, stainless steel and aluminum. Best of all, a high regard for quality has always been second nature with us. We're ready, *right now*, to sit down with you over your blueprints . . . or to send you detailed information on our equipment, our capacity, etc. Your inquiries are invited.

CALL, WRITE OR WIRE US TODAY!

CORRY-JAMESTOWN MFG. CORP.

CORRY, PENNSYLVANIA

Makers of famous Steel-Age office furniture

4 in Fig. 2. Figure 3 shows the horizontal and vertical deflections as functions of time. (Recall that the amplitudes of the deflections were made equal.) Points 1 and 3 correspond to those times when the two deflections are equal and of the same sign. At points 2 and 4 the deflections are of equal magnitude but opposite sign. The dimension C is equal to the value of p in Fig. 3 multiplied by $\sqrt{2}$ and dimension D is equal to q multiplied by this same factor. Therefore $C/D = p/q$.

It follows from inspection of Fig. 3 that at point 1 both deflections are equal to $a \sin (180-\theta)/2 = a \cos (\theta/2) = p$. Similarly at point 4 the deflections are $a \sin (\theta/2) = q$. This gives

$$\frac{C}{D} = \frac{q}{p} = \frac{a \sin (\theta/2)}{a \cos (\theta/2)} = \tan (\theta/2)$$

It may be undesirable at times to adjust the deflection amplitudes equal as required in the method as presented thus far. Disturbing of the gain settings can be avoided by use of the geometrical construction shown in Fig. 4. The horizontal and vertical lines are drawn tangent to the ellipse. The diagonals of the rectangle thus formed are the directions along which C and D should be measured. Figure 4 will be readily recognized as nothing more than Fig. 2 "stretched" horizontally by an appropriate factor. This stretching does not alter the ratio C/D.

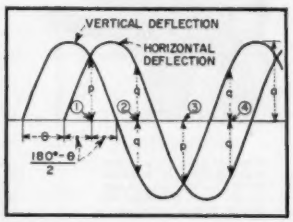


FIG. 3—Horizontal and vertical deflections as a function of time

What may appear to be a formidable drafting job to perform on the face of the cro is really not so difficult if the usual celluloid coordinate scale is used to indicate the position of the tangent lines. With a small

FERROXCUBE-3C cores are nickel-free

APPLICATIONS:

- I-F TRANSFORMERS
- PERMEABILITY TUNING DEVICES
- LOW-LOSS INDUCTORS
- SATURABLE CORE REACTORS
- HORIZONTAL OUTPUT TRANSFORMERS
- DEFLECTION YOKES
- TELEPHONE LOADING COILS

When your drawings call for Ferroxcube 3C cores for your TV deflection yokes and horizontal output transformers, you can forget about procurement problems. These ferrite cores are nickel-free . . . . and delivery will be made exactly as scheduled by you!

Improved temperature stability, high saturation flux density, and high permeability are among the other advantages of Ferroxcube 3C.

Complete technical data is yours for the asking in Engineering Bulletin FC-5101A, available on letterhead requests. ★ ★ ★ ★ ★ ★ ★ ★ ★

FERROXCUBE

THE MODERN CORE MATERIAL

FERROXCUBE CORPORATION OF AMERICA

• A Joint Affiliate of Philips Industries and Sprague Electric Co., Managed by Sprague •

SAUGERTIES, NEW YORK

A compact, lightweight, wideband oscillograph...

the DU MONT Type 334-A for...

- **field maintenance of microwave, radar, and pulsed systems.**
- **setting up relay links, transmission line terminations, mobile communication systems, etc.**
- **testing airborne equipment, as well as testing mobile ground equipment.**
- **trouble-shooting and maintaining electronic computers, television, telemetering, and associated circuits.**

Price $750

The Du Mont Type 334-A is a small, highly portable, wideband oscillograph intended for general field engineering and maintenance.

•

Utilizes Type 2AP1-A cathode-ray tube with a magnifier, and calibrated scale with variable illumination. Produces a trace of high resolution.

•

Both driven and recurrent sweeps are provided in three ranges from 50 to 50,000 cycles per second for recurrent sweeps, and from 280 to 5 μ seconds duration for driven sweeps.

•

Inputs include a high-impedance input with three attenuator positions; a low-impedance position; and a ½-μ second delay line terminated by a 10-step attenuator with a total of 20 db attenuation in 2 db steps, plus a fine gain control. Deflection factor of vertical amplifier at full gain is 0.3 p-p volt/inch with frequency response of amplifier within 30% from 40 cycles to 2.5 MC. Pulse response, 0.14 μ second.

•

Weight: less than 30 lbs. Overall dimensions (including eyeshade): only 8" x 9" x 21". Operates from power source of 115 ± 10 volts at any frequency between 50 and 1200 cycles per second.

•

In addition to sturdy metal carrying case, Type 334-A is supplied with two probe assemblies, two 10-foot coaxial patching cords, and 15-foot power cord.

ALLEN B. DU MONT LABORATORIES, INC., INSTRUMENT DIVISION • CLIFTON, N.J.

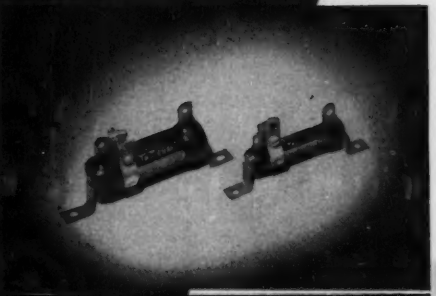
TRU-OHM
VITREOUS ENAMELED RESISTORS

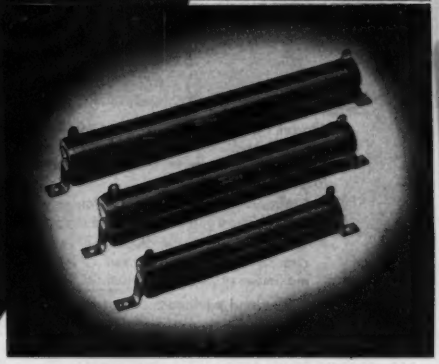
DELIVERY

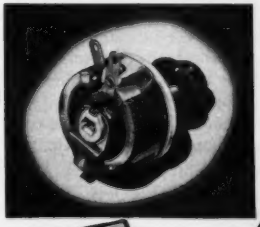
QUALITY

PRICE

ENGINEERING





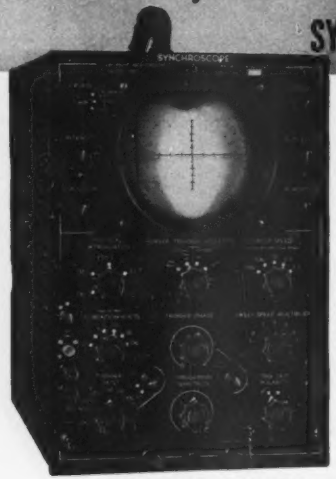


TRU-OHM
Power Rheostat

TRU-OHM PRODUCTS Division of Model Engineering & Mfg., Inc.

2800 N. Milwaukee Avenue, Chicago 18, Ill.
Factory: Huntington, Indiana

MAXIMUM PERFORMANCE at MINIMUM COST with the Browning OSCILLOSYNCHROSCOPES ON-5A ON-5X SYNCHROSCOPE P4-EX



Models ON-5A and ON-5X are designed as basic, highly flexible laboratory instruments for general pulse work. Their specifications include:

- **High-gain vertical amplifiers.**
- **Triggered sweeps, from an external trigger or from the input signal.**
- **Recurrent sweeps, at a repetition rate of 10 to 100,000 per second.**
- **Vertical input delay of 0.45 microsecond (ON-5X).**

Model P4-EX is designed for applications requiring a triggered sweep, and where the signal levels met do not demand extremely high-gain amplification. Its many outstanding features include:

- **Internal trigger, at a repetition rate of 50 to 5000 per second, easily synchronized with an external trigger if desired.**
- **Output trigger, with the same range of repetition rates, which can be continuously phased to lead or lag the sweep start by a maximum of 500 microseconds**

Detailed specifications and performance data available promptly on your request.

These new instruments represent a high level of precision design and versatility of application at remarkably low cost. Major features that are common to all three instruments include:

- Type 5UP cathode-ray tube, operating at an accelerating potential of 2600 volts. P1, P7 and P11 screens are available.
- Sweep writing rate continuously variable from 1.0 to 25,000 microseconds per inch.
- Sweep calibration in microseconds per horizontal scale division, accurate to plus or minus 10%.
- Vertical amplifier flat within 3 db from 5 cycles to 5 megacycles.
- Vertical calibration voltages, at accuracy of plus or minus 5% for Model P4-EX, and plus or minus 10% for Models ON-5A and ON-5X.
- Vertical amplifier input step attenuator.
- CRT cathode connection externally available, for application of blanking or marker pulses.

NET PRICES, F.O.B. Winchester, Massachusetts:
P4-EX . . . $465.00 ON-5A . . . $485.00 ON-5X . . . $535.00

Write today for **FREE BULLETINS** giving detailed specifications and performance data.

BROWNING Laboratories, Inc. Winchester, Mass.

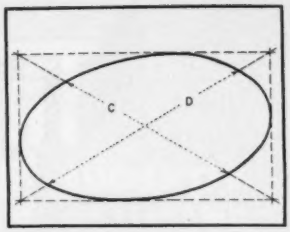


FIG. 4—Geometrical construction used to avoid disturbing of gain settings

ruler placed in the proper position the required dimensions can be measured.

REFERENCES

(1) J. P. Taylor, Cathode-Ray Antenna Phasemeter, ELECTRONICS, p 62, April 1939.
(2) E. R. Kretzmer, Measuring Phase at Audio and Ultrasonic Frequencies, ELECTRONICS, p 114, Oct. 1949.
(3) P. G. Sulzer, Victor Voltage Indicator, ELECTRONICS, p 106, Dec. 1949.

Small-Station Program Recording

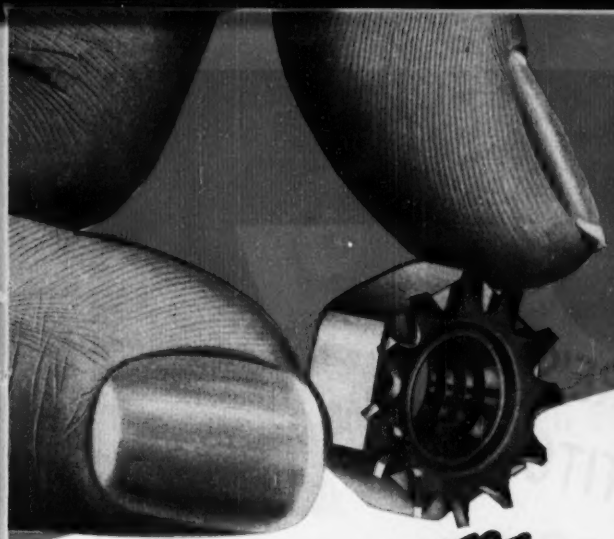
By KEN DOLAN
Chief Engineer
Radio Station WARA
Attleboro, Mass.

DURING THE REGULAR broadcast day it is almost impossible for an independent radio station to make recordings consisting of records, transcription and voice unless they are fortunate enough to have spare turntables and amplifiers. The regular turntables are in almost constant use.

Station WARA has two studios. One is a large studio used primarily for originating programs consisting of two or more people; the other is a combination studio-control room, announcer operated.

An RCA Transcription Player is used in the record library for auditioning new records, transcriptions and sound effects. Ninety percent of all programming is done from the studio-control room, leaving the large studio with two microphone inputs not being used.

By adding a volume control, switch and matching transformer to the existing transcription player, it is possible to make recordings with music on tape or disks. Previous to this setup, when any recordings were made, they would have to be done during a 15-minute newscast, half-hour women's pro-



IF YOU USE NUTS—

TRY KEPS
TRADE MARK

. . . PRE-ASSEMBLED NUTS AND SHAKEPROOF® LOCK WASHERS

Get these important benefits now!

IMPROVED QUALITY — every nut is positively locked against vibration loosening!

INCREASED PRODUCTION — KEPS start easily and spin freely on the bolt!

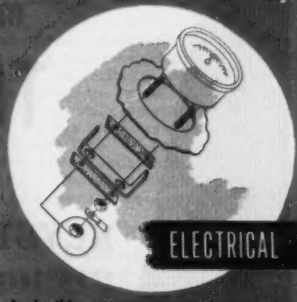
FASTER DRIVING — tedious, costly separate lock washer handling is completely eliminated!

AUTOMOTIVE

KEPS are used here, together with SHAKEPROOF Molding Clips, to hold an ornamental molding strip in place. Because every nut is protected against vibration loosening with a pre-assembled SHAKEPROOF Lock Washer, KEPS are ideal for applications of this type.

FARM EQUIPMENT

On this tractor steering connection, subject to severe operating vibration, the positive locking feature of KEPS is particularly important. Further, because the lock washer can't drop off or get lost, servicing operations are greatly simplified.



ELECTRICAL

As in this [illegible] connection, KEPS are used in all types of electrical assembly. The pre-assembled SHAKEPROOF Lock Washer bites deep into the clamping surfaces to provide positive, efficient electrical contact.

SHAKEPROOF inc.

"Fastening Headquarters"

T.M. REG. U.S. PAT. OFF.

DIVISION OF ILLINOIS TOOL WORKS

St. Charles Road, Elgin, Illinois

In Canada, Canada Illinois Tools Ltd., Toronto, Ont.

FREE SAMPLE KIT FOR TESTING

Send for yours today!

THERE'S NO SUBSTITUTE FOR

"CAN DO"

Especially in custom-made and special purpose

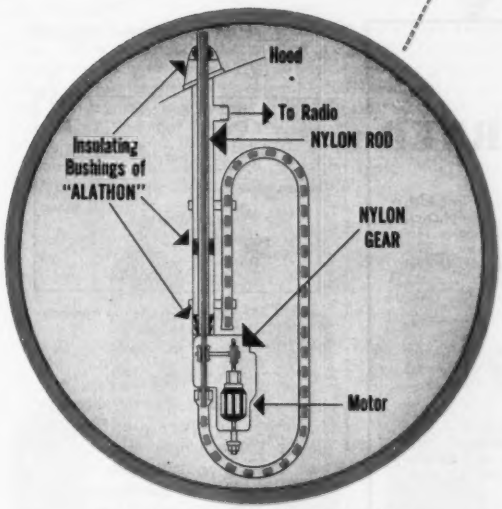
TRANSFORMERS

KEYSTONE PRODUCTS COMPANY

904-6 Twenty-Third Street, Union City, N. J., UNion 6-5400

Send us your name and address . . . request "THE KEYSTONE" . . . it's an interesting little magazine we're sending to transformer users every month.

New Packard antenna design employs two Du Pont plastics



When driver pushes button, motor-driven worm gear turns nylon gears, which turn spring-loaded pulleys. Nylon rod is driven up by pulleys, forcing "live" members upward. Rod coils into trombone-like shape (dotted line) when antenna is lowered. (*Automatic antenna used on 1951 Packards made by Casco Products Corp., Bridgeport, Conn.*)

Nylon plastic and "Alathon" polythene resin meet mechanical and electrical requirements for automotive antenna

Two Du Pont plastics materials—nylon and "Alathon"* polythene resin—are playing key roles in the success of this new motor-driven antenna used on Packard automobiles. A 4½-foot flexible rod which raises and lowers the "live" members is made of nylon, as are the two gears that transmit power from the motor to pulleys which drive the rod upward and downward. Insulating bushings, which must have very low moisture-absorption and excellent dielectric properties at radio frequencies, are molded of "Alathon."

The rod must have an unusual combination of properties. Most important of these: it must be rigid enough to force the antenna up and down, yet flexible enough to fold into a trombone-like position when the antenna is down; and it must also have good dielectric properties. Only nylon was found to meet the mechanical requirements, while at the same time maintaining a high "Q" and low capacity. The nylon rod and gears have been subjected to as many as 80,000 cycles—many more times than they could possibly be called on to withstand during the life of any car. Neither shows any sign of wear.

Both nylon and "Alathon" are finding a number of uses in molded parts for electrical equipment, in addition to their many well-known applications in wire and cable. Nylon is used in such items as coil forms, insulator bushings, grommets, motor slot liners, switch components . . . "Alathon" in radio and television parts, potting compounds, etc.

For additional information about nylon, "Alathon" and other Du Pont plastics, write:

*REG. U. S. PAT. OFF.

E. I. du Pont de Nemours & Co. (Inc.),
Polychemicals Dept., District Offices:
350 Fifth Avenue, New York 1, New York
7 S. Dearborn St., Chicago 3, Illinois
845 E. 60th St., Los Angeles 1, California

DU PONT
REG. U. S. PAT. OFF.
BETTER THINGS FOR BETTER LIVING
. . . THROUGH CHEMISTRY
Polychemicals
DEPARTMENT
PLASTICS • CHEMICALS

Conductor E. G. Keenan uses the Turner 9D on the Milwaukee Road's Midwest *Hiawatha* train.

FIRST IN FAVOR
on the Milwaukee Road.. the TURNER
HAN-D 9D!

Perhaps you don't own many trains in which you could install Turner 9D microphones, but chances are you're called on now and then to recommend a microphone for paging, public address, ham rig, mobile use or traveling mike broadcasting. In this event, you may be sure of your ground when you use or recommend the Turner "Han-D" 9D!

The Turner 9D is the handiest and most useful microphone made. Hang it, hold it, or mount it on any mike stand. It's carefully engineered for maximum response to voice, but also delivers smooth, natural response to music pickups. It will not blast from close speaking.

Drop it — kick it — freeze it — heat it — the Turner 9D will take more punishment per square inch than any microphone you ever owned — and continue to give superior performance. Positive contact slide switch permits on-off operation.

MODEL 9D DYNAMIC — Recommended for severe service conditions and extremes of climate and temperature. Level: 52 db below 1 volt/dyne/sq.cm. at high impedance. Response: 100-7000 c.p.s. Complete with removable 7-ft. single conductor shielded cable set. 50, 200, 500 ohms or high impedance.

MODEL 9X CRYSTAL — Equipped with high quality, shock-mounted, humidity protected crystal for indoor or outdoor use. Level: 52 db below 1 volt/dyne/sq.cm. Response: 60-7000 c.p.s. Complete with removable 7-ft. single conductor shielded cable set.

Model 9D
List price $28.50

Model 9X
List price $23.50

TURNER

Write for complete literature

THE **TURNER** COMPANY

905 17th Street N.E., Cedar Rapids, Iowa

IN CANADA—Canadian Marconi Co.
Toronto, Ont. & Branches

EXPORT—Ad. Auriema, Inc.
89 Broad Street, New York 4

Crystals licensed under patents of the Brush Development Co.

grams or any program that could be done without turntables. These programs would originate from the large studio.

This arrangement clears out the regular turntables and, for a short period of time, the audition bus in the console can be used for making recordings. The only other alternative is to come in after sign-off hours, with resulting rushed and poor-quality work.

When the dpdt switch, Fig. 1, is thrown to the record position, the playback arm is disconnected from the grid circuit of the self-contained amplifier in the transcription player and is connected to the matching transformer high-impedance primary. The secondary matches into 250 ohms.

A regular microphone plug and

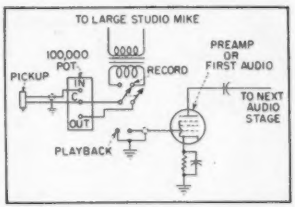


FIG. 1—Circuit changes to the transcription player

cable are connected to the secondary in order to plug into the large studio microphone input. The 100,000-ohm potentiometer controls the input to the microphone preamplifier in the console so as not to overload it and cause distortion. When the dpdt switch is thrown to the playback position, the transcription player functions as a normal record player.

When a recording is to be made from the large studio, the switch on the player is thrown to RECORD. The output cable is plugged into the studio microphone input receptacle and a regular microphone is plugged into another studio microphone input. The console monitor and the corresponding large studio microphone switches are placed on AUDITION.

Output from the monitor amplifier is fed into either a tape recorder or disk recorder. The end result

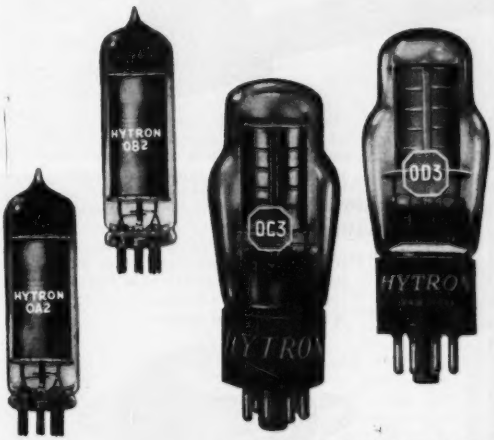
"When we think of V-R tubes, we think of CBS-HYTRON"

TUBES ARE KNOWN BY THE COMPANY THEY KEEP

It's automatic with scores of top-flight manufacturers. They turn to CBS-Hytron for the miniature OA2, OB2 and standard OC3, OD3.

That's only natural. They know CBS-Hytron has the know-how... know-how gained from making over 15,000,000 voltage regulators. They know CBS-Hytron supplies these apparently simple tubes to either JAN or commercial specifications. (In fact, CBS-Hytron's factory tests of VR tubes are much tougher than JAN.) And they know CBS-Hytron . . . top producer of VR tubes . . . can be depended upon for prompt delivery.

Follow the leaders yourself. Buy the best. Order *your* gaseous voltage regulators from CBS-Hytron.



Write for Complete Free Data on
CBS-HYTRON voltage-regulator tubes

CBS HYTRON

HYTRON
A DIVISION OF COLUMBIA BROADCASTING SYSTEM, INC.

MAIN OFFICE: Salem, Massachusetts

Reads like the blue book of electronics... this list of famous companies who from long experience buy the best in voltage-regulator tubes... CBS-Hytron.

Admiral Corporation • Airborne Instruments Lab., Inc. • Aircraft Armaments, Inc. • Aircraft Radio Corp. • Airesearch Mfg. Co. • Applied Physics Corp. Applied Research Laboratories • Arma Corporation A.R.F. Products, Inc. • Atomic Instrument Co. Audio Products Corp. • Ballantine Laboratories, Inc. • Arnold O. Beckman, Inc. • Bell Aircraft Corp. • Bell Telephone Laboratories, Inc. • Bellaire Electronics, Inc. • Bendix Aviation Corp. • Berkeley Scientific Corp. • Bill Jack Scientific Instrument Co. • Bright Radio Laboratories • The Brinnell Co. Browning Laboratories, Inc. • J. H. Bunnell & Co. Cambridge Instrument Co., Inc. • The Allen D. Cardwell Mfg. Corp. • CBS-Columbia, Inc. • CBS Television • Collins Radio Co. • Connecticut Telephone & Electric Corp. • Consolidated Vultee Aircraft Corp. • Cornell-Dubilier Electric Corp. • Crosley Division, Avco Mfg. Corp. • DDD Manufacturing Co. • Douglas Aircraft Co., Inc. • Allen B. DuMont Laboratories, Inc. • Edo Corporation • Eicor, Inc. • Electro-Physical Laboratories, Inc. • Electrotechnic Corp. • El-Tronics, Inc. • Fada Radio and Electric Co., Inc. • Fairchild Guided Missiles Div., Fairchild Engine and Airplane Corp. • Federal Manufacturing and Engineering Corp. • Federal Telecommunication Laboratories, Inc. • Federal Telephone and Radio Corp. • Ford Instrument Co., Div. of Sperry Corp. • Gaveco Laboratories, Inc. • General Communication Co. General Precision Laboratory, Inc. • General Radio Co. • Gilfillan Bros., Inc. • Gonset Company • The Gray Mfg. Co. • The Hallicrafters Co. • The Hammarlund Mfg. Co., Inc. • Harvey-Wells Electronics, Inc. • Hazeltine Electronics Corp. • Hewlett-Packard Co. • Hickok Electrical Instrument Co. • Hoffman Radio Corp. • Hubbell & Miller Co. • Industrial Control Co. • Industrial Development Engineering Associates, Inc. • Jack & Heintz, Inc. Jackson Electrical Instrument Co. • Kepco Laboratories, Inc. • Lavoie Laboratories, Inc. • Lear, Incorporated • Lewyt Corporation • Link Radio Corp. • Loral Electronics Corp. • Lyman Electronic Corp. • Lysco Mfg. Co., Inc. • P. R. Mallory & Co., Inc. • The Glenn L. Martin Co. • The W. L. Maxson Corp. • McDonnell Aircraft Corp. • McElroy Manufacturing Corp. • Melpar, Inc. • Midwest Engineering Development Co., Inc. • Minshall-Eatey Organ, Inc. • Motorola, Inc. • National Company, Inc. National Electrical Machine Shops, Inc. • National Research Corp. • National Research Council, Canada • New London Instrument Co. • Nuclear Measurements Corp. • Nutone, Inc. • Photobell Co. Pilot Radio Corp. • Portable Electric Tools, Inc. Precision Apparatus Co., Inc. • Press Wireless Mfg. Co., Inc. • Radiation, Inc. • Radio Development & Research Corp. • Radio Engineering Laboratories, Inc. • Rauland-Borg Corp. • Raymond Rosen Engineering Products, Inc. • Raytheon Mfg. Co. Reed Research, Inc. • Sanborn Company • Sangamo Electric Co. • Schuttig & Company, Inc. • Sentinel Radio Corp. • Servomechanisms, Inc. • Setchell Carlson, Inc. • Shallcross Mfg. Co. • F. W. Sickles Div., General Instrument Corp. • Sierra Electronic Corp. • A. F. Smuckler & Co., Inc. • Sonar Radio Corp. • Spencer-Kennedy Laboratories, Inc. • The Stamford Electronics Co. • Fred Stein Laboratories • The Superior Electric Co. • The Technical Materiel Corp. • Telechrome, Inc. • Tel-Instrument Co., Inc. • Times Facsimile Corp. • Tracerlab, Inc. • Trad Television Corp. • Transducer Corp. • United Scientific Laboratories, Inc. • Varo Mfg. Co., Inc. Wells-Gardner & Co. • Western Electric Co. • Western Sound & Electric Labs., Inc. • Westinghouse Electric Corp. • Weston Electrical Instrument Corp. • Weston Laboratories • Wilcox Electric Co., Inc. • Witco Mfg. Co.

In addition **to many other prominent manufacturers, the U. S. Army, Navy, Air Force, Coast Guard, AEC, CAA, FCC, National Bureau of Standards, government development laboratories and other government agencies, well-known research laboratories and universities, foreign countries, and the nation's leading electronic parts distributors.**

Put FORCE behind your vibration testing

...more than 2500 pounds of it with this big MB exciter

See MB Exciters at The I R E Show Booth S-16, March 3-6

POWER AND ENDURANCE feature this new MB Model C25 Vibration Exciter—today's largest and most dependable electromagnetic shaker.

It has already proved its heavy-duty capacity in a number of important military vibration testing applications. In frequencies from 3 to 500 cps, it easily develops required forces to produce accelerations of 15g with 100 lb table load or 20g with 60 lb table load, for example.

Like all MB Exciters, Model C25 Shaker provides easy, accurate, continuous control of force and frequency. It allows "scanning" for response to vibration of parts under test. Electrically interlocking controls assure trouble-free operation. Automatic cycling control available to meet specifications of MIL-E-5272.

Vibration testing shakes out troubles before they start. It's not only a "must" for much military equipment, but also a good idea for *any* product. If you'd like to know more about it, why not contact "headquarters" for vibration engineering—MB! You'll find the help and advice you're seeking.

APPROVED MOUNT FOR ISOLATING VIBRATION

This Type 17 MB Vibration Isolator incorporates a principle first achieved by MB in mountings. It has equal spring rates in all directions in order to isolate all modes of motion with equal efficiency. Available for loads from 0.5 to 100 lbs to meet MIL-I-5432 (AN-I-16a) specification on vibration isolation. Write Dept. 5 for details.

MORE DETAILS

New bulletin containing specifications, operational information and helpful hints on usage, is now available on the complete line of MB Vibration Exciters which includes models from 10 lbs to 2500 lbs force output. Ask for **Bulletin No. 1-VE-5.**

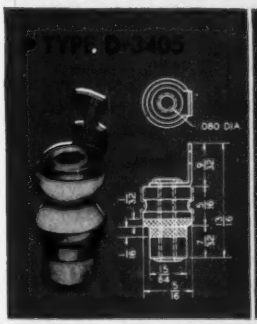
THE MB MANUFACTURING COMPANY, INC.
1060 STATE STREET, NEW HAVEN 11, CONN.

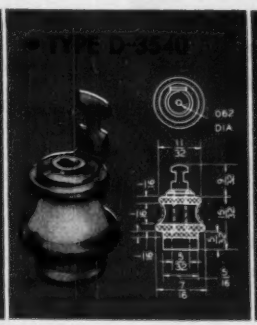
PRODUCTS AND EQUIPMENT TO CONTROL VIBRATION . . . TO MEASURE IT . . . TO REPRODUCE IT

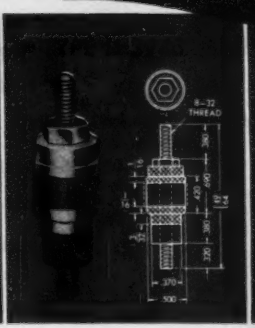
Solve your hermetic seal problems with RUGGED! GENERAL CERAMICS SOLDER-SEAL TERMINALS

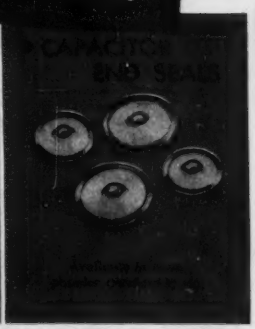
General Ceramics low-loss STEATITE sealed leads feature superior mechanical strength that insures permanent, positive hermetic sealing under practically any operating condition. Immune to severe thermal shock, they are easily soft-soldered to closures without developing the strains that are an incipient cause of trouble in many other types of leads. There are no rubber or plastic gaskets to deteriorate. Resistance to mechanical shock and vibration is excellent. The types shown are standard and can be supplied promptly from stock. For complete information on these and for consultation on custom-made terminals to your specification, phone, call or write today.

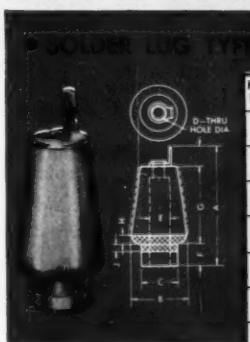
SOLDER-SEAL OFFERS
- EASE OF ASSEMBLY
- SUPERIOR STRENGTH
- NON-DETERIORATION
- PERMANENT SEALING
- RESISTANCE TO HEAT
- EXTREMELY LOW-LOSS



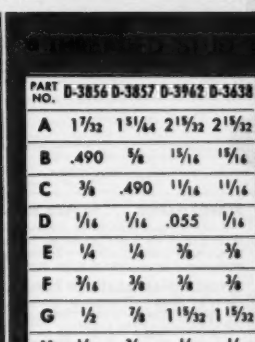








PART NO.	D-3342	D-3346	D-3350	D-3349
A	1 1/32	1 13/32	2 9/32	3 3/16
B	.490	5/8	15/16	3/4
C	3/8	.490	11/16	9/16
D	.095	.095	.130	.130
E	3/16	1/4	3/8	1/4
F	3/16	3/8	3/8	5/16
G	1/2	7/8	1 15/32	2 7/16
H	1/16	3/32	1/8	1/8
J	3/32	1/8	1/8	1/8



PART NO.	D-3856	D-3857	D-3962	D-3638
A	1 7/32	1 51/64	2 15/32	2 15/32
B	.490	5/8	15/16	15/16
C	3/8	.490	11/16	11/16
D	1/16	1/16	.055	1/16
E	1/4	1/4	3/8	3/8
F	3/16	3/8	3/8	3/8
G	1/2	7/8	1 15/32	1 15/32
H	1/16	3/32	1/8	1/8
J	3/32	1/8	1/8	1/8
K	6-32	6-32	8-32	10-32

---- GLAZE SURFACE
▩ METALLIZED SURFACE

See our exhibit at
BOOTH #47
IRE SHOW, NEW YORK

GENERAL STEATITE INSULATORS

General CERAMICS AND STEATITE CORP.

Telephone: Perth Amboy 4-5100

GENERAL OFFICES and PLANT: KEASBEY, NEW JERSEY

MAKERS OF STEATITE, TITANATES, ZIRCON PORCELAIN, FERRAMICS, LIGHT DUTY REFRACTORIES, CHEMICAL STONEWARE, IMPERVIOUS GRAPHITE

Announcing

ADVAN SERIES 400 RECORDERS

MODEL 400-A
with
Half-Track Head

•

MODEL 401-A
with
Full-Track Head

•

15 & 7 1/2
Inches Per Sec.

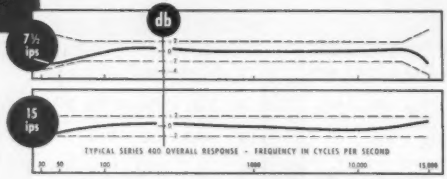
Full REMOTE CONTROL
Solenoid operated mechanisms for all mechanical motions.

also *Featuring*

- UNIFORM RESPONSE . . . to 15,000 cps at 7½ ins. per sec.
- LOW NOISE & DISTORTION LEVEL . . . signal-to-noise ratio over 55 db at either tape speed (as defined by NARTB).
- PUSH BUTTON OPERATION
- LONG LIFE . . . precision built.
- LOW MAINTENANCE . . . even with continuous use.

4 to 1 TAPE SAVING

The valuable tape saving ability of Series 400 Recorders is clearly illustrated above — the young lady holds four reels which contain the identical program formerly requiring the sixteen reels shown on table. No other recorder can give this remarkable tape saving because no other recorder is capable of 15,000 cycle performance at 7½ ins. per sec., on but half the width of the tape!



PERFORMANCE . . . beyond comparison!

Published specifications of Ampex Recorders are conservative as these typical check-out graphs on Series 400 show. Ampex check-outs always exceed guaranteed performance but even the guaranteed performance is sufficient to make Ampex the world's finest recorder!

PORTABLE IN SINGLE CASE or for RACK MOUNTING

INTERCHANGEABILITY OF TAPES . . . another unrivalled superiority of Ampex. This means that recordings made on any Ampex can be played back on any other Ampex (of like speed) with identical high fidelity and timing.

ASK FOR BULLETIN A-211

. . . gives complete description and specifications of the Series 400 Ampex Magnetic Tape Recorders.

AMPEX ELECTRIC CORPORATION
Redwood City, California
Distributors in Principal Cities

AMPEX *Magnetic* RECORDERS

is a transcription or recording with music having been made without using the regular transcription turntables.

Automatic Morse-Code Typer

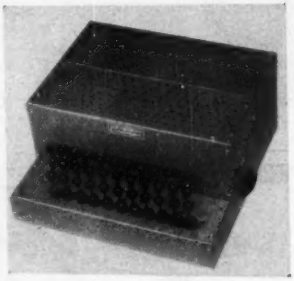
By NATHANIEL G. A. DORFMAN
President
Codetyper Laboratories
New York, New York

IT IS POSSIBLE to cause the formation of perfect Morse code characters by means of electronic equipment which allows the keying of radio transmitters by persons not necessarily familiar with Morse code.

The apparatus to do this, complete with internal power supply, resembles a typewriter closely. In place of punctuation marks, telegraphers symbols are used. By depressing the keys, perfect code is sent at speeds which can be set from 10 wpm to 125 wpm.

The unit code is a basic concept upon which the operation of the Codetyper functions and is founded upon the timing relations of the characters in Morse code to the smallest interval which is the dot marker. Using the dot as a base and calling it 1, there are up to 19 units within all characters, numbers and punctuation marks, counting all spacing units internal to the characters as one unit. All letters are aligned so that the last unit is number 19 and all counts are backward starting from 19. This establishes a common reference point regardless of the length of the letter.

The unit interval generator section generates the rectangular

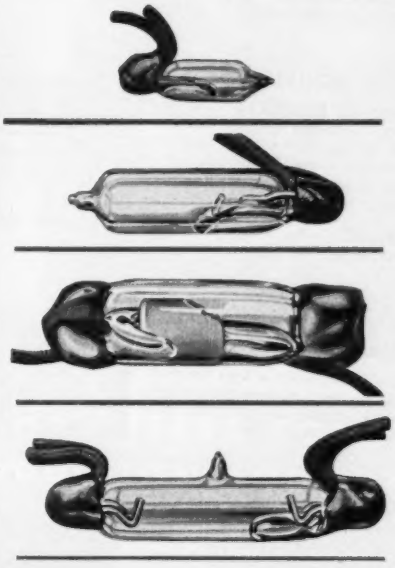


The Codetyper with keyboard and speed-control knob on right-hand side

Honeywell Mercury Switches

are precise, dependable components for automatic controls

Let a MICRO SWITCH Engineer show you how you can "use Honeywell Mercury Switches as a principle of good design"



• Honeywell Mercury Switches have been recognized for thirty years as precise, dependable switching components for many types of automatic controls. Their low initial cost, long service life, and freedom from maintenance makes them ideal components for use in many products where accurate repeat performance is desired.

Honeywell Mercury Switches are available with load limits from as little as 1/3 amp. up to 45 amp. MICRO SWITCH field engineering service, fully experienced in every type of switching problem, will gladly help you select and apply the Honeywell Mercury Switch which will serve you best.

We invite you to "let a MICRO SWITCH engineer show you how you can use Honeywell Mercury Switches as a principle of good design." Call your nearest MICRO SWITCH branch office.

Visit the MICRO Booth
Radio Engineering Show
Grand Central Palace, New York
MARCH 3-6, 1952

MICRO SWITCH

FREEPORT, ILLINOIS

MICRO Snap-Action Switches...Honeywell Mercury Switches

A DIVISION OF MINNEAPOLIS-HONEYWELL REGULATOR COMPANY

EQUIPMENT FOR AM-FM-TV STATION USE—BY Gray RESEARCH

GRAY professional equipment for broadcast station use is conceived, designed, engineered and built by specialists in the audio-video field. The products here described are widely used, approved and recommended by networks and independent stations. Broad acceptance by the industry is our best testimonial to the high quality and serviceability built into equipment manufactured by Gray.

Gray TELOP *(TELevision Optical Projector)*

Makes PROFITS GROW for TV Stations. The Gray Telop projects low-cost, easily produced TV 'commercials.' Without keystoning, any two photos, titles, slides, etc., or small objects may be broadcast with superimposition, lap dissolve or fade-out. Four optical openings. Strip material may be used horizontally or vertically with Stages #2 and #3. (For full details write for Bulletin T-101.)

Gray STAGE #2

Attaches to three optical openings of the Telop. Accommodates roll stock *vertically* to televise commentary or the commercial in the same way movie introductions are projected.

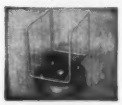
Gray STAGE #3

Attaches to optical openings of the Telop. News ticker tape fed from 8-mm reels is projected on any part of the screen, top to bottom, horizontally. May be used with test pattern or other commercial.

Gray TV CAMERA TURRETS

Enable a Single Camera to Serve up to 8 Projectors

MODEL 556



Centered on a rugged 'square' pedestal, requires a minimum of space. Heavy duty ball bearings. Rotates 360°.

Gray LIGHT BOX for Transparencies

Provides back lighting for Telop use.

Gray REVERSE READING CLOCK

For use where reversal is required. Designed to permit superimposing of the commercial or other copy.

Gray MULTIPLEXER Model 600

A precision arrangement of mirrors for operation of pairs of projectors simultaneously into a single TV camera or individually into two separate cameras. *Enables a greater number of projectors to be used with fewer highly expensive TV cameras.*

Gray TRANSCRIPTION ARMS

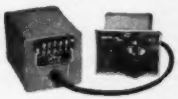
NEW Viscous-Damped Model 108-B Arm

For all records — 33⅓, 45 and 78 r.p.m. Radically new suspension development on the viscous damping principle *for perfect tracking* of records and elimination of tone arm resonances. Instant cartridge change with automatic correct stylus pressure. Solves all transcription problems. IDEAL FOR LP RECORDS. For Pickering and GE cartridges.

Model 106-SP Arm

Designed to meet strictest requirements of modern highly compliant pickup cartridges. Three cartridge slides furnished enable GE 1-mil, 2½-mil or 3-mil cartridges or Pickering cartridge to be slipped into position in a jiffy. No tools or solder! Superb reproduction of 33⅓, 45 or 78 r.p.m. records. Low vertical inertia, precisely adjustable stylus pressure.

Gray EQUALIZERS



MODEL 602 EQUALIZER has been specially engineered to provide constant velocity frequency response for both conventional and LP records. Four steps—flat, transcriptions, good records, poor records. Gray Equalizers used as standard professional equipment by broadcast stations.

MODEL 603 — Has 5 control positions. For both GE and Pickering cartridges.

Gray Color Television Monitor

This latest product of Gray Research was developed for professional monitoring of color telecast of the CBS field sequential system.

Gray MILITARY PRODUCTS

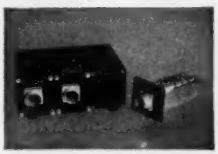


Illustration shows typical airplane controls made for Hamilton Standard, Division of United Aircraft Corporation. Other military developments and products include video indicators, intricate mechanisms, trainers, electronic-mechanical development contracts.

See you at the I.R.E. Show, Booths S-9, S-10

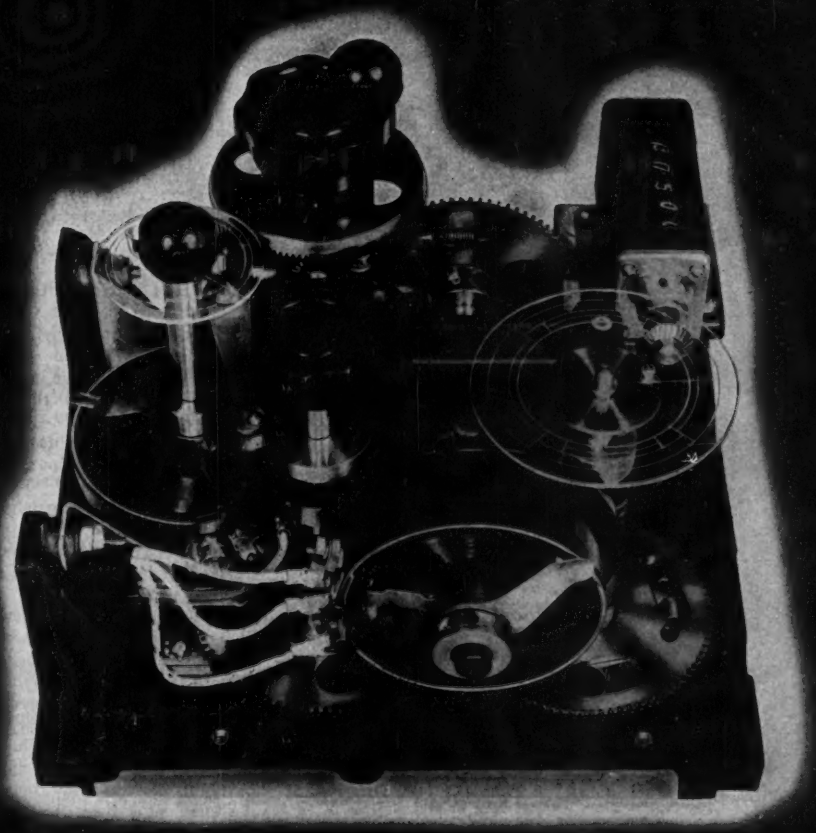
GRAY RESEARCH

and Development Co., Inc., 16 Arbor St., Hartford 1, Conn.

Milton C. Gittus
President

Division of The GRAY MANUFACTURING COMPANY—Originators of the Gray Telephone Pay Station and the Gray Audograph

Precision Electro-Mechanical Equipment ...for All Industries



ATLAS OFFERS COMPLETE ENGINEERING, PRODUCTION AND ASSEMBLING FACILITIES

Take an intricate electro-mechanical product in the pilot stage . . . "iron out the kinks" . . . mass produce it . . . and assemble it with finest precision. That's the service Atlas "Precisioneers" offer American Industry. Extra hands to speed the output of vitally needed products that must be sub-contracted.

Atlas has an engineering and development staff capable of designing for mass production. Skilled craftsmen of the high speed machine tools, precision grinders, gear cutters and stamping presses. Experienced and exacting operators are on every assembly line to assure precision finished assemblies.

Atlas "Precisioneers" are master craftsmen of every step of the way in producing fine precision electro-mechanical assemblies — all services under one roof, under one responsibility. Whether you need a sub-contractor to mass produce assemblies for you or a source of supply for precision parts, Atlas offers you complete facilities. Speed your production — write for "Precisioneers For Industry."

ATLAS METAL STAMPING COMPANY
KENSINGTON AND CASTOR AVENUES
PHILADELPHIA 24, PENNA.

SUPPLYING TODAY'S NEEDS

Present-day jeweler's "magic" is seen in this Time-O-Graff, used to check accuracy of watches. Made by the Borg Equipment Division of the George W. Borg Corp., it relies on the delicate mechanism of a JK H18-5 crystal.

and DESIGNING TOMORROW'S

Even newer crystal design is reflected in the JK-8-T Temperature Controlled Crystal. A boon to manufacturing savings, it is directly interchangeable with several other JK crystals—without need for wiring changes!

THE JK-8-T MARKS A PATHWAY FOR THE STARS!

More astounding every day grow the uses for James Knights crystals in every phase of industry and science! Recently the JK-8-T — teamed with the JK-07 and JK H-18 crystals — has been used in "celestial timers" in observatories. It's part of the intricate mechanism which keeps huge telescopes beamed directly at celestial bodies in their path across the heavens. Still another dramatic application of James Knights crystals which are designed or adapted to fill every possible crystal need!

Crystals FOR THE *Critical*

Critical tolerances and precision work have put James Knights UP FRONT. Their aim: To furnish every type crystal it is possible to make—whether out-of-date, or still unheard of. To be sure, consult J-K design engineers first!

THE JAMES KNIGHTS CO.
SANDWICH 3 ILLINOIS

WRITE for free catalog, listing JK crystals.

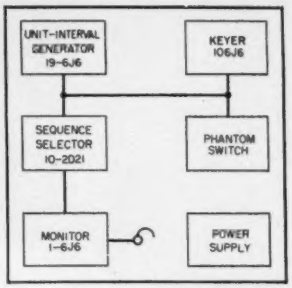


FIG. 1—Block diagram of the Codetyper

pulses that form the dot marking and spacing intervals. No dash markers are generated, they are formed by action of the sequence selectors upon the keyers. To generate the 19 units that are required there are 19 6J6's. All pulse generators are univibrators producing two different output pulses, a rectangular pulse of 15 to 125 milliseconds duration which is fed to the keyer section and a sharp spike pulse 180 deg removed which is used to trigger the numerically adjacent unit.

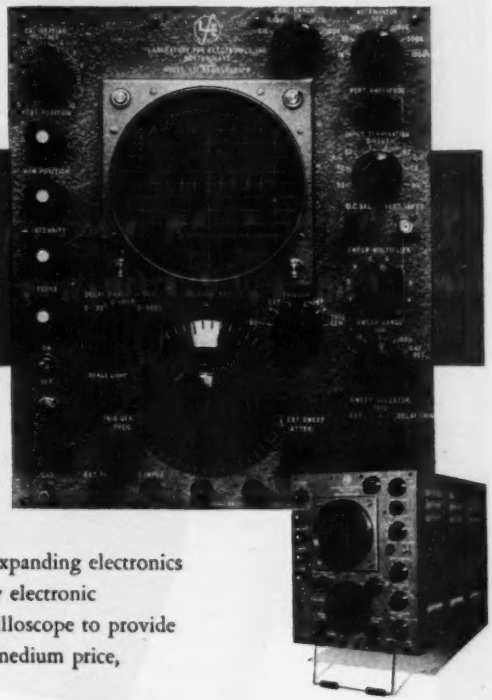
As all pulse generators are normally quiescent and are hooked up so that they will only deliver a pulse to the keyers when they are triggered off from the preceding stage, all unit interval generators can be seen to be effectively in time series. Therefore, a trigger applied to the unit interval generator number one will effectively travel down the chain, setting off all interval generators up to the last or 19.

A shorter combination may be obtained by inserting a triggering pulse somewhere along the chain. Control is had on all 19 interval generators by varying one potentiometer which changes the duration of the 19 units simultaneously, precisely and over wide range from minimum to maximum.

The keyer section functions to form the marking and spacing intervals that comprise a code character and to arrange these intervals in the proper sequence so that the time intervals supplied by the unit generators are fashioned into a Morse code character upon the keying relay which is used to actuate the radio transmitter. To do

NEW, Advanced design Oscilloscope...

for precise, quantitative studies of pulse waveforms, transients and other high or low speed electrical phenomena



LFE Model 401 Oscilloscope
A high gain, wide band, versatile, general purpose instrument

Advances in electronics have placed greater demands on the time, frequency, and amplitude measuring capabilities of laboratory oscilloscopes. LABORATORY FOR ELECTRONICS, INC., recognizing the ever-increasing requirements of the rapidly expanding electronics industry, and using specifications set forth by electronic engineers, has developed the Model 401 oscilloscope to provide the features and conveniences required in a medium price, general purpose instrument.

SPECIFICATIONS

Y-Axis

Deflection Sensitivity – 15 millivolts peak-to-peak/cm
Frequency Response – DC to 10Mc
Transient Response – Rise Time – 0.035 microseconds
Signal Delay – 0.25 microseconds
Input line terminations – 52, 72, or 93 ohms, or no termination, for either AC or DC input
Calibrating Voltage – 60 cycle square wave.
Input Imp. – 1 megohm, 30 mmf.

X-Axis

Sweep Range – 0.01 sec/cm to 0.1 microseconds/cm
Delay Sweep Range – 5-5000 microseconds in three ranges – continuously adjustable
Triggers – Internal or External, + and –, or 60 cycles, or delayed trigger outputs are available at suitable binding posts.
Built-in trigger generator for triggering external circuits and sweeps.

General

Low capacity probe
Functionally colored control knobs conveniently grouped
Folding stand for better viewing
Adjustable scale lighting
Facilities for mounting oscilloscope cameras
Dimensions – 12½" wide, 15" high, 19" deep
Weight – 50 lbs.

See the LFE Oscilloscope demonstrated at the New York I. R. E. Show, March 3, 1952, fourth floor, booth 461, or write for complete information.

LABORATORY for ELECTRONICS, INC.

43 LEON STREET BOSTON 15, MASS.

ALL RANGES WITH THIS ONE CONTROL

Model 630

Just *one* knob—extra large—easy to turn—flush with the panel, controls all ranges. This one knob saves your time—minimizes the chances of "burn-outs" because you don't have to remember to set another control. You can work fast with Model 630 with your eyes as well as your hands. Look at that scale—wide open—easy to read, accurately. Yes, this is a *smooth TV* tester. Fast, safe, no projecting knobs, or jacks, or meter case. Get your hand on that single control and you'll see why thousands of "Model 630's" are already in use in almost every kind of electrical testing

ONLY $39.50 AT YOUR DISTRIBUTOR

In Canada: Triplett Instruments of Canada, Georgetown, Ontario

FOR THE MAN WHO TAKES PRIDE IN HIS WORK

Triplett

TRIPLETT ELECTRICAL INSTRUMENT COMPANY · BLUFFTON, OHIO, U.S.A.

NEW TUBES for

Pulse Modulator Applications

UNITED

HIGH VOLTAGE—HIGH VACUUM DIODES

These new United Graphite Anode Diodes have been developed to fulfill the important aims of the Armed Services program for decreased size . . . increased ruggedness . . . and increased reliability of Electron Tubes. Complete technical data sent on request.

Type 577

Max. Dimen.:
Height 7-3/8"
Diameter 2-1/16"

Ratings:

Ef	5.0 volts
If	10.25 amps.
epx	25 kv
Io	300 ma
Ib	1.50 amps.

Type 578

Max. Dimen.:
Height 6-1/2"
Diameter 2-5/16"

Ratings:

Ef	5.0 volts
If	6.0 amps.
epx	40 kv
Io	100 ma
Ib	750 ma

Type 576

Ratings:

Ef	5.0 volts
If	14.0 amps.
epx	25 kv
Io	900 ma
Ib	2.5 amps.

Max. Dimen.:
Height 7-1/2"
Diameter 2-5/16"

Type 371-B

Max. Dimen.:
Height 8-3/4"
Diameter 2-5/16"

Ratings:

Ef	5.0 volts
If	10.3 amps.
epx	25 kv
Io	300 ma
Ib	1.5 amps.

Type 3B24WA*

Max. Dimen.:
Height 4-1/2"
Diameter 1-9/16"

Ratings:

Ef	5.0 volts
If	3.0 amps.
epx	20 kv
Io	60 ma
Ib	300 ma

Type 3B29

Max. Dimen.:
Height 4-3/4"
Diameter 1-9/16"

Ratings:

Ef	2.5 volts
If	4.75 amps.
epx	16 kv
Io	65 ma
Ib	250 ma

*3B24WA is Ruggedized Type employing *new Bonded Thoria filament;* placed on JAN preferred list October 1951 in lieu of 3B24W.

UNITED ELECTRONICS, 42 Spring Street, Newark 2, N. J.

SINCE 1934

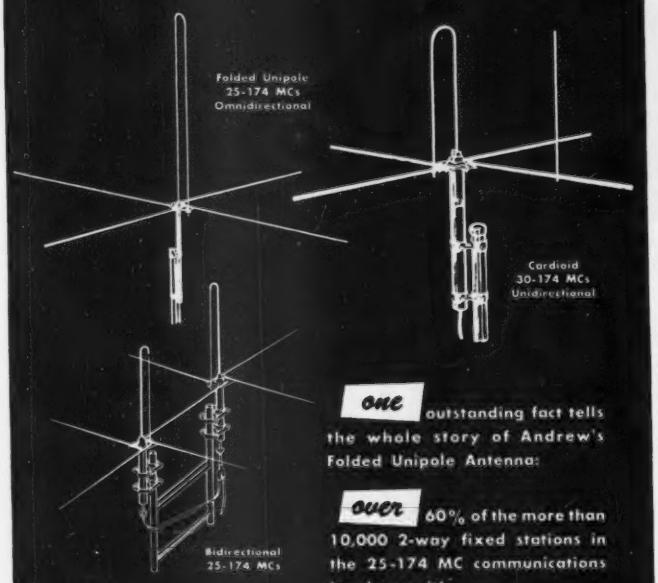
Andrew

folded unipole

25-174 MCs

Outsells

all others combined!



one outstanding fact tells the whole story of Andrew's Folded Unipole Antenna:

over 60% of the more than 10,000 2-way fixed stations in the 25-174 MC communications bands use it!

The Andrew Folded Unipole comes in modified versions to provide directional patterns and hurricane resistance. For complete information write for Bulletins 38C and 64.

Andrew CORPORATION
363 EAST 75th STREET CHICAGO 19

ANDREW

phone Triangle 4-4400

TRANSMISSION LINES FOR AM-FM-TV • ANTENNAS • DIRECTIONAL ANTENNA EQUIPMENT
ANTENNA TUNING UNITS • TOWER LIGHTING EQUIPMENT

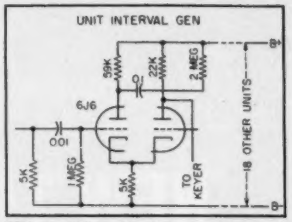


FIG. 2—Schematic diagram of one of the 19 unit interval generators

this there are 10 dual triode 6J6 tubes used.

The sequence selector section consists of nine gating tubes and one eraser tube making 10 shielded grid thyratrons of the 2D21 type. All thyratrons are biased to current cutoff and arranged to be triggered on by the keyboard control through the phantom switch network.

The phantom switch must supply a trigger voltage to the interval generators. This can be accomplished by picking off the network through a suitable decoupling voltage to raise the cathode potential of the generator preceding the one to be triggered. This will cause the coupling capacitor to put a positive-going pulse on the generator to which it is connected and cause that stage to trigger off.

For the convenience of the operator as well as a built-in method of checking the operation, a monitor circuit is provided.

The Codetyper uses 40 tubes and therefore the design requires that the servicing of the system be quickly and easily accomplished. Toward this end and with the prospect of making a compact unit possible, all units except the power supply are constructed as potted plug-in cells.

Video-Detector Sound Amplifier

A RATHER unconventional vido-detector circuit is employed in recent Magnavox tv receivers.

The video second detector and first sound i-f amplifier are combined in one pentode, a 6AU6. Detection is accomplished by the diode action of the grid and cathode of the pentode tube. The 4.5-mc component for intercarrier sound is recovered at the plate of the tube after amplification. The video com-

Admiral TV
Picture Tube Leads are insulated with
NATVAR 400
EXTRUDED PLASTIC TUBING

In this Admiral Model 121 K 16 TV with 20" picture tube, the 2nd anode lead from the high voltage rectifier carries 12,500 volts to the picture tube. This important lead is insulated and protected with Natvar 400 Extruded Plastic Tubing.

Natvar

Natvar Products

- Varnished cambric—straight cut and bias
- Varnished cable tape
- Varnished canvas
- Varnished duck
- Varnished silk
- Varnished special rayon
- Varnished Fiberglas cloth
- Silicone coated Fiberglas
- Varnished papers
- Slot insulation
- Varnished tubing and sleeving
- Varnished identification markers
- Lacquered tubing and sleeving
- Extruded plastic tubing and tape
- Extruded plastic identification markers

Ask for Catalog No. 22

Admiral Corporation, in the past decade, has grown to be one of the largest and best known makers of TV and Radio Sets and Electrical Appliances. Leaders in research, design, and engineering, they have succeeded by offering *quality* merchandise at the lowest possible price.

To safeguard this quality, Admiral is extremely careful in the selection of component parts and materials. They use Natvar 400 Extruded Plastic Tubing because of its excellent electrical and mechanical properties, and because it is dependably uniform.

Natvar 400 and other Natvar flexible electrical insulating materials are available either from your wholesaler's stock or direct from our own.

THE NATIONAL VARNISHED PRODUCTS Corporation

Telephone Rahway 7-3800 — Cable Address NATVAR: Rahway, N. J.

201 RANDOLPH AVENUE ★ WOODBRIDGE, NEW JERSEY

Eight ML-5682's mounted in a Doherty high efficiency linear amplifier designed for 500 kW output.

The ML-5682

A High-Power Coaxial Triode for Full-Power Operation to 88 mc/sec.

The development and commercial production of the ML-5682, a new water- and air-cooled coaxial triode for very high power operation, is an important contribution to all phases of modern electronic development. It is of particular significance in the present effort to provide the highest possible power in international broadcast applications. It finds wide application in high power AM, FM and TV broadcasting, in particle accelerators and in electronic heating. It is the key tube type in the highest power AM transmitters being built today.*

The ML-5682 is an unusually compact, rugged, high-power electron tube ideal for all high-frequency applications. It is an all-ring-seal triode capable of long-life operation at 9kVdc plate voltage and 170 kW plate input at a frequency of 88 mc/s. Operation at 16 kVdc plate voltage and 300 kW plate input is permissible up to 30 mc/s. This tube is ideal for cavity operation and its low impedance makes it advantageous for broad-band service.

*Includes State Department's Voice of America Transmitters.

Outstanding design features include:

High-conductivity, gold plated kovar glass-to-metal seals.

Sturdy electrodes.

Integral anode water jacket.

Quick-change water coupling.

High-conductivity, heavy-wall copper anode designed to dissipate in excess of 100 kw.

Multi-strand thoriated-tungsten filament cathode completely balanced and stress free throughout tube life.

Grid capable of unusually high heat dissipation contributing to maximum stability of tube performance and circuit operation.

For full technical information on the ML-5682 or other Machlett tube types write to Machlett Laboratories, Inc., Springdale, Connecticut, or contact your nearest Graybar or Westrex office.

Machlett Industrial and Broadcast Tubes will be exhibited at the 1952 I.R.E. Show—Booth 96-97

MACHLETT OVER 50 YEARS OF ELECTRON TUBE EXPERIENCE

fine wire

MADE FINER

custom drawn
custom insulated
custom spooled
—to your most exacting requirements

Spool after spool after spool—as much or as little as you require. For our facilities are flexible and extensive enough to serve the largest and the smallest user alike with custom-made fine wire.

Let us have your specifications and requirements. Our Winsted Division will meet and maintain your specifications. Which explains why Winco fine wires are the first choice of radio-electronic and electrical manufacturers whose products are noted for reliability and long life.

hudson WIRE COMPANY

GENERAL OFFICES: OSSINING, N. Y. • WINSTED DIVISION: WINSTED, CONN.

We solicit your wire problems, specifications and requirements. We shall be happy to develop, produce and supply whatever fine wires you need.

BARE WIRES

Copper, Brass, Zinc, Tinsel, Nichel-Silver, Cadmium Oxygen-free Copper, Silver-plated Bronze, Phosphor-Bronze, Silver, Lead Wire, Fuse Wire, Specialty Wires

TEXTILE COVERED WIRES

Nylon, Celanese, Silk, Cotton, Rayon, Fiberglas

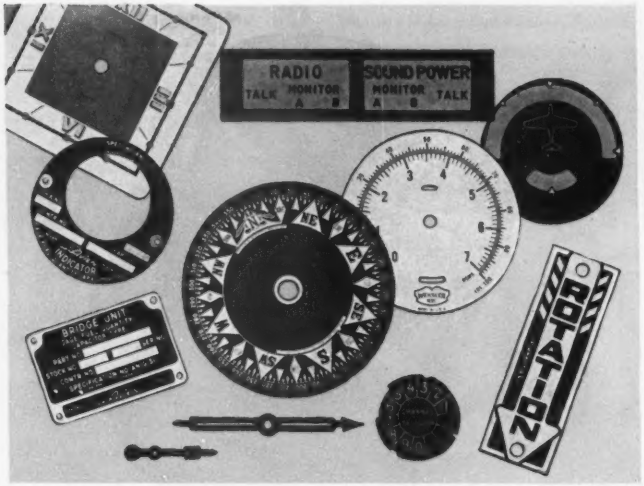
Available on bare or enameled wire; single or double covered.

INSULATED WIRES

MATERIALS	TYPES	COVERINGS
Copper	Instrument Tubing	Plain and Heavy Enamel
Aluminum	Litz	Formvar
Iron	Multiplied and Twisted	ESnol (Liquid Nylon)
Copper-clad Steel		Cement-coated Enamel

SILVER-PLATED WIRES

Silver plated wires, in coarse and fine sizes, for high-frequency conduction. Also intended for use in high-temperature applications, taking the place of tinned wire. Available in various sizes and constructions.



DIALS OR NAMEPLATES OF ANY TYPE

— at savings that will surprise you!

Because of our company name, you may think of U. S. Radium Corporation as a source of only *luminous* dials or nameplates. Actually we make self-luminous, fluorescent, phosphorescent, and *non*luminescent types, including Alumilite, lithographed or etched aluminum, brass, steel, or stainless steel — finished in lacquer, nickel, chromium, or silver — with black, color, or luminescent markings. In other words, you name it — we make it!

Moreover, having produced millions of dials and nameplates for all kinds of instruments, timepieces, and other uses, we've learned to combine mass-production techniques with our traditional standards of accuracy and fine quality. Result: you get exactly the dials or nameplates you want — at lower costs than you are likely to think possible.

We are, of course, equipped to meet Government specifications . . . and to produce large quantities of routine-type dials or nameplates, or small runs of special, high-accuracy scientific ones.

To find out how we can provide your apparatus with better-designed or lower-cost dials or nameplates, write to Department E3, United States Radium Corporation, 535 Pearl Street, New York 7, New York.

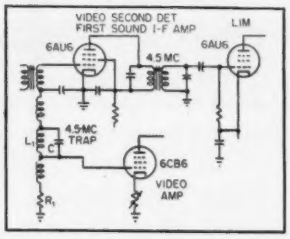
Other Products of U. S. Radium

RADIOACTIVE FOILS
(alpha-ray ionization sources)
IONOTRON STATIC ELIMINATORS
RADIUM LOCATORS:
lenses, buttons, screws, markers
LUMINOUS RETICLES
and other specialties

POWDERS:
cathode-ray tube and television tube
SILHOUETTE ILLUMINATION
of clocks, watches, and instruments
RADIATION MATERIALS:
radiation, neutron, and standard-light sources

UNITED STATES RADIUM CORPORATION

BETTER DIALS AND NAMEPLATES AT LOWER COST



Circuit for using a single pentode as video detector and sound intercarrier amplifier

ponent is recovered at the detector load R_1. The effect is identical to having a diode directly coupled to a pentode. However, since the grid and cathode of the pentode act as a detector and produce the same results, the diode is eliminated.

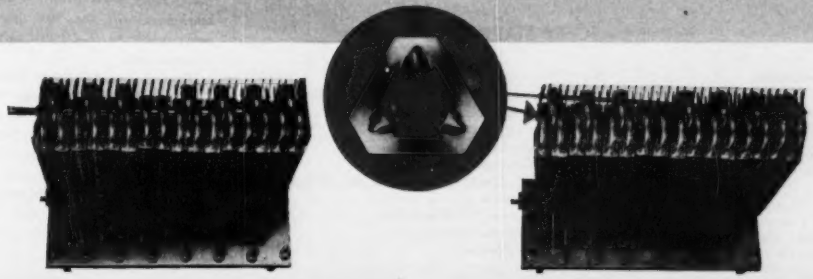
The video voltage developed across the diode load resistor R_1 is of negative polarity. This signal is amplified by a direct-coupled video amplifier, a 6CB6, and coupled to the cathode of the picture tube. To obtain the proper video response, the total stray and circuit capacitance had to be kept to a minimum. For this reason, the third video i-f coil had to be modified, since a standard bifilar coil would contribute about 70 $\mu\mu$f of capacitance. Peaking coils provide the necessary high-frequency response for the video amplifier. Capacitor C and L_1 resonate at 4.5 mc to attenuate the 4.5-mc beat at the video amplifier and increase the amplitude of the 4.5-mc carrier to the first sound i-f amplifier.

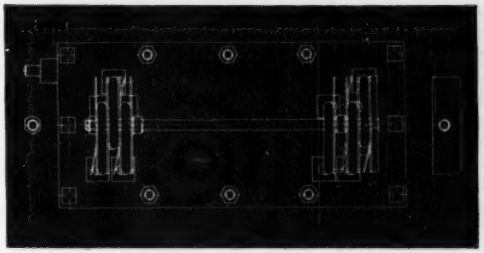
The 4.5-mc f-m carrier produced by the diode mixing action is amplified and transformer-coupled to the sound limiter, 6AU6. A double-tuned circuit is used to provide good selectivity since a large portion of the demodulated video frequencies also exist in the plate circuit.

Photoelectric Dew-Point Hygrometer

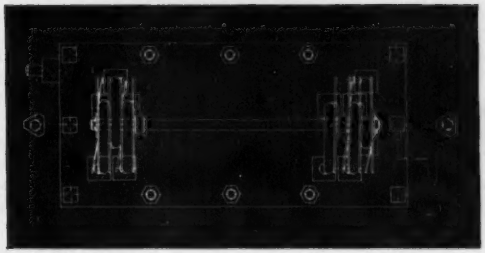
THE convenient means of measuring the water content of the atmosphere down to −85 C described in the November 1951 issue of Electronics, p 136 is a feature of the instrument manufactured by Elliott Brothers Ltd., Century Works, Lewisham, London, S.E. 13, England.

2 WALDES TRUARC TRIANGULAR RETAINERS REPLACE NUTS... CUT MATERIAL AND ASSEMBLY COSTS 52%





OLD WAY–Tie rod for thermal tubes required threading at both ends, a jam nut at top, a drilled and tapped cast iron tube-rest at bottom. Assembly was slow, costly.



NEW WAY–Truarc Retainers (triangular type) simply push into position at both ends of rod...hold securely without grooves, threads, or nuts. Assembly is inexpensive, speedy!

When the Grinnell Co., Providence, R. I. redesigned their Thermolier Unit Heater to include Waldes Truarc Retaining Rings, they were able to cut down on scarce raw material... eliminate the many machine operations entailed in nut fastening—for a savings of 26½¢ per unit! Truarc Triangular Retainers are self-locking...have unusually high thrust capacity... can be applied at high speed by unskilled labor.

Re-design with precision engineered Truarc Rings and you too will cut costs. Wherever you use machined shoulders, bolts, snap rings, cotter pins, there's a Waldes Truarc Retaining Ring designed to hold parts together better, with a never-failing grip. Quick, easy to assemble and disassemble.

Find out what Truarc Rings can do for you. Send your blueprints to Waldes Truarc engineers for individual attention, without obligation.

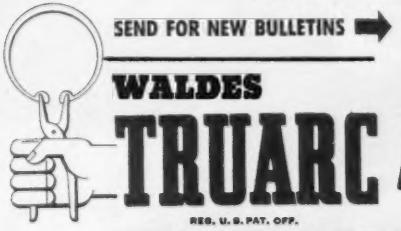
WALDES TRUARC RINGS MADE THESE SAVINGS POSSIBLE...

OLD WAY		NEW WAY	
Parts:	Cost Per Unit	Parts:	Cost Per Unit
tube rest, threaded rod, jam nut	$.306	plain rod, 2 Truarc Rings	$.060
Assembly	.202	Assembly	.183
	$.508		$.243

TOTAL SAVINGS PER UNIT WITH TRUARC RINGS $.265

SEE THE WALDES TRUARC EXHIBIT. I R E SHOW, GRAND CENTRAL PALACE, N.Y. C., MARCH 3 through 6th. Booths 358 & 359•ASTE SHOW, CHICAGO AMPHITHEATRE, MARCH 17 through 21st. Booth 751

For precision internal grooving and undercutting...Waldes Grooving Tool.



SEND FOR NEW BULLETINS

WALDES TRUARC

REG. U. S. PAT. OFF.

RETAINING RINGS

WALDES KOHINOOR, INC., LONG ISLAND CITY 1, NEW YORK

WALDES TRUARC RETAINING RINGS AND PLIERS ARE PROTECTED BY ONE OR MORE OF THE FOLLOWING U.S. PATENTS: 2,383,967; 2,383,968; 2,410,855; 2,420,921; 2,428,341; 2,430,795; 2,441,849; 2,455,165; 2,483,390; 2,483,393; 2,487,903; 2,487,803; 2,491,306; 2,508,081 AND OTHER PATENTS PENDING.

Waldes Kohinoor, Inc., 47-16 Austel Place, L. I. C. 1, N. Y.
Please send engineering specifications and data on Waldes Truarc Retaining Ring types checked below. E-034

- ☐ Bulletin #5 Self-locking ring types
- ☐ Bulletin #6 Ring types for taking up end-play
- ☐ Bulletin #7 Ring types for radial assembly
- ☐ Bulletin #8 Basic type rings
- ☐ Send me information about the Waldes Grooving Tool.

Name_____

Title_____

Company_____

Business Address_____

City_____ Zone_____ State_____ 5678

Production Techniques

Edited by JOHN MARKUS

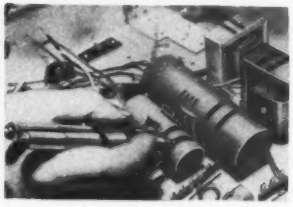
RTMA Date-Coding 244
Automatic Spaghetti-Cutter Meets Production Requirements 244
Soldering with Two Irons 246
Protecting Speakers 246
Flexible Threaded Shaft Serves as Overhead Conveyor for Empty TV Dollies 246
Hot-Blade Wire-Stripper 248
Twin-Lead Connector 252
Assembly-Line Merry-Go-Round 256
Cleaning Safety Glass 268
Wire-Stripper Keeps Busy 272
Production Testing of Selenium Cells 272
Applying Paint with Oiler 284
Slide for Transformers 288
Sample-Testing CRT Cables 288
Self-Counting Parts Trays 292
Plastic Clothespins Serve as Defect Indicators 292
High-Speed I-F Alignment 304
TV Chassis-Centering Jigs 308
Tangle-Preventer 312

THIS department presents techniques for expediting the production of military and commercial electronic equipment and components. Here, production and methods engineers will see how problems comparable to theirs are solved in other plants.

Topics covered range from the jigs and fixtures of incoming inspection to the tricks of final packaging, all showing how to boost output, simplify an operation, improve quality or cut costs.

Contributions are welcomed, and will be paid for, with full credit to the author and his company

RTMA Date-Coding



Color-dating larger components with taped-together fountain brushes

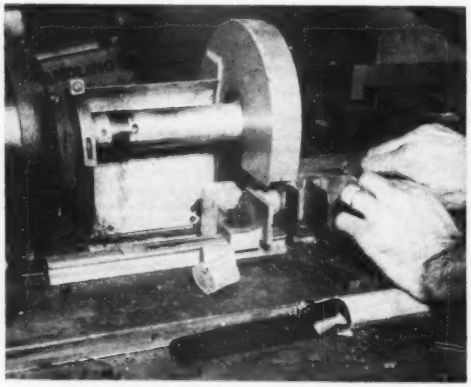
TELEVISION receiver parts likely to be returned for replacement under the manufacturer's warranty are quickly color-coded with year and month of production by taping together appropriate color combinations of fountain brushes and marking the parts with a single stroke. One color represents the last digit in the year, from 0 to 9. The second color gives the month from 1 to 9, and three brushes are used for 10, 11 and 12 during the last three months of the year.

Ambiguity between month and year stripes is not ordinarily important since the usual warranty is 90 days or less, but for precise dating the year mark can be placed closest to the edge of each component. As used by CBS-Columbia in its Brooklyn plant, this marking method is intended only as a rough check to show up parts that are turned in a year or more later for free replacement.

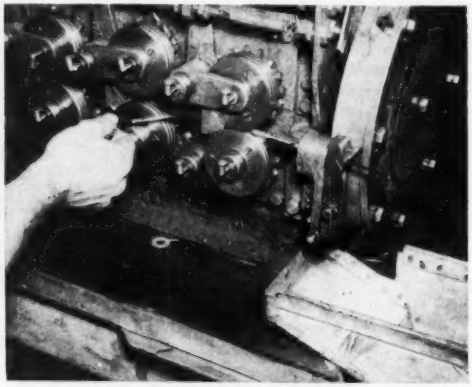
Automatic Spaghetti-Cutter Meets Production Requirements

SLEEVING or spaghetti is cut to precise lengths at high speed, with clean right-angle cuts and no frayed threads, by a simple modification of a standard wire bus-cutting machine at RCA's wire-cutting plant in Camden.

Larger grooves were machined in the final pair of feed wheels and copper tubing added to guide the spaghetti through these wheels. Lengths of cut pieces are easily



OLD METHOD—Bundle of 36-inch spaghetti was wrapped with masking tape and cut to desired short lengths on circular saw having length gage. Tape then had to be peeled off by hand



NEW METHOD—Simple modification of standard bus-cutting machine does job automatically, almost as fast as operator can thread new lengths of spaghetti into the copper guide tube.

KESTER SOLDER

SEE US!
Booth No. 252
I.R.E. SHOW

NEW KESTER "44"
RESIN CORE SOLDER

**ESPECIALLY FOR TV . . . RADIO WORK . . .
EVERYTHING ELECTRONIC**

In speed of action for fast soldering, this product far surpasses anything in the Industry today. Unbelievably more active and mobile . . . absolutely non-corrosive and non-conductive.

For an actual demonstration in your plant, contact Kester's Technical Department.

Conforms with following specifications:
Federal QQ-S-571b
Army-Navy-Air Force Mil-S-6872 (AN-S-62)
U. S. Air Force No. 41065-B-Method 31

KESTER SOLDER COMPANY
4204 Wrightwood Ave., Chicago 39
Newark, N. J. • Brantford, Canada

changed by changing the speed of the cutter wheel with relation to the feed wheels, using the existing gear-changing system of the machine.

With the available gear changes and 8 blades on the cutter wheel, the range of lengths is ½ to 2 in. Removing alternate cutter blades changes the range to 1 to 4 inches.

Soldering With Two Irons

WHEN soldering operations are concentrated in the smallest possible number of positions on an assibly line, maximum soldering speed is attained. To maintain this speed without cooling an iron too much, many plants provide two irons per worker for alternate use.

Protecting Speakers

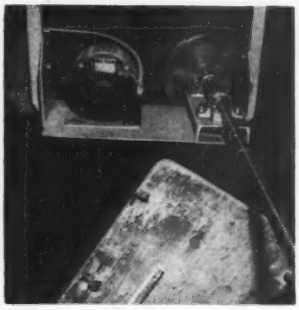
TWO ways of protecting paper diaphragms of radio speakers from the thumbs of assembly-line workers are used in Emerson's Jersey City plant.

One method involves slipping a square of corrugated cardboard between the speaker and a chassis bracket for protection while the chassis is going down the line.

The other method, used chiefly when the chassis has no suitable holding bracket for cardboard, involves using a speaker mounting gasket that extends inward over much of the cone. Holes punched in this large gasket minimize interference with sound waves. A forming operation pushes the punched gasket outward so that the diaphragm cannot touch it during extreme in-and-out movements.

Inward-widened speaker gasket prevents thumbs of workers from punching hole in diaphragm

Flexible Threaded Shaft Serves as Overhead Conveyor for Empty TV Dollies

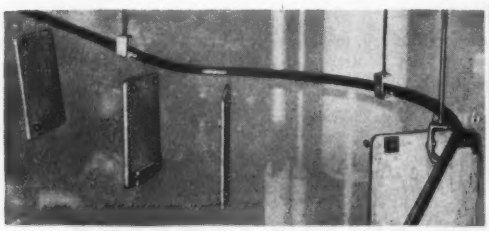


Motor drive for shaft, and type of hook used on pallet

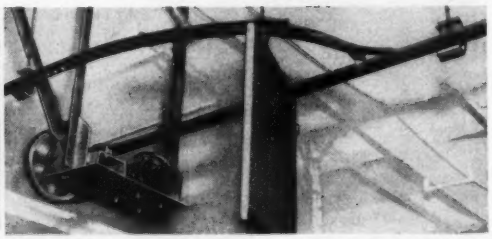
A SIMPLE and inexpensive overhead conveyor installation at Emerson's Jersey City plant returns empty television chassis dollies a total of 240 feet from the end of the assembly line to the start of the line. Motive power is a flexible threaded shaft that rotates in a U-shaped channel and is driven at one end by a motor. Each dolly has a wire hook like a coat hanger; when this is hooked over the rotating shaft, the dolly is moved lengthwise along the shaft by the threads. The system was introduced by Martin Richmond, facilities planning engineer for the company, at a total installed cost of under $3,000.

Formerly, empty dollies were tossed into a hand truck and moved in batches to the start of the line; this took about half the time of one man and tied up several material-moving trucks. By eliminating this, the conveyor system will pay for itself in about one year. An important added benefit is complete elimination of damage to dollies. When trucked, rough handling frequently damaged the chassis-holding brackets and the ball casters, causing line jam-ups since the damage was usually not detected until the dolly was in use again. Reduction in maintenance cost of dollies is another benefit accruing from the conveyor.

The conveyor used is an adaption of a garment-industry coat-hanger conveyor made by Teleflex Inc., 248 W. Wingohocking St., Philadelphia. The flexible shaft turns in a U-shaped steel channel with sides bent inward about 15 degrees from parallel so the shaft cannot jump out. The shaft itself has a core of longi-



Pallets hooked over threaded-shaft conveyor ride easily around 90-degree bends and up grades. Conveyor support rods are about five feet apart



Pallet ready to drop off end of one line and slide down metal strip to start of next line, which is driven by motor hanging from ceiling at left

All Band, Direct Reading

SPECTRUM ANALYZER

10 MC to 21,000 MC

The Model LSA is the result of years of research and development. It provides a simple and direct means of rapid and accurate measurement and spectral display of an rf signal.

Outstanding Features:

- Continuous tuning.
- One tuning control.
- 5 KC resolution at all frequencies.
- 250 KC to 25 MC display at all frequencies.
- Tuning dial frequency accuracy 1 percent.
- No Klystron modes to set.
- Broadband attenuators supplied from 1 to 12 KMC.
- Frequency marker for measuring differences 0-25 MC.
- Only four tuning units required to cover entire range.
- Microwave components use latest design non-contacting shorts for long mechanical life.
- Maximum frequency coverage per dollar invested.
- 5 inch CRT display.

Model LSA

The instrument consists of the following units:

Model LTU-1 RF Tuning Unit—10 to 1000 MC.
Model LTU-2 RF Tuning Unit—940 to 4500 MC.
Model LTU-3 RF Tuning Unit—4460 to 16,520 MC.
Model LTU-4 RF Tuning Unit—15,000 to 21,000 MC.
Model LDU-1 Spectrum Display Unit.
Model LPU-1 Power Unit.
Model LKU-1 Klystron Power Unit.

Polarad

PRECISION LABORATORY INSTRUMENTS

BROAD BAND MICROWAVE ATTENUATOR

Model SIJ

4 kmc to 12.4 kmc

Polarad's Broad Band Microwave Attenuator is intended for use as an external attenuator in microwave measurements with signal sources, receivers and for power measurements. Its useful frequency range is from 4000 mc to 12,400 mc. Model SIJ can be used as a standard calibrated attenuator or to couple a small amount of energy from a high level source for circuit protection, or for monitoring and for measurement purposes without introducing discontinuities or to insure rf circuit isolation.

By its use a Polarad Microwave Signal Source or a laboratory oscillator is converted into a signal generator.

Features:

- Continuously variable attenuation.
- Stub tuned; 50 ohm impedance.
- Waveguide beyond cutoff attenuator.

WIDE BAND VIDEO AMPLIFIER

Model VT 10 CPS to 20 MC

Designed for use as an oscilloscope deflection amplifier for the measurement and viewing of pulses of short duration and rise time. Excellent for TV, both black and white and color applications.

Model VT

Features:

- Flat frequency response from 10 cps to 20 mc ±1.5 db.
- Uniform time delay of 02 microseconds.
- Gain of 50 db.
- Frequency compensated high impedance attenuator calibrated in 10 db steps from 0-50.
- Fine attenuator covers a 10 db range.
- Phase linear with frequency over entire band.

MICROWAVE SIGNAL SOURCES

Models SSR, SSL, SSS, SSM, SSX

634 MC to 11,000 MC

For use as a reliable source of microwave energy in transmission loss measurements, standing wave determination, etc. Unidial Control for accuracy and ease of operation. Direct reading (no mode charts to consult). Frequency determination accurate to 1% through use of present calibration and temperature compensated klystrons.

Five Microwave Signal Sources are available to cover the frequency range from 634 MC to 11,000 MC. Units ruggedly constructed, mounted on aluminum castings to insure mechanical stability. Klystron reflector voltage automatically tracked with tuning of the klystron cavity to provide unidial control. Signal sources supplied complete with klystron.

FREQUENCY MARKER

Model FM-L

950 mc to 2,040 mc

Polarad's Frequency Marker, Model FM-L, provides accurate frequency determination to within 10 kc over the frequency range 940 to 2020 mc.

The Frequency Marker produces calibration signals at precisely determined frequencies and these signals may be displayed and compared with an unknown rf signal, whose frequency can then be accurately measured.

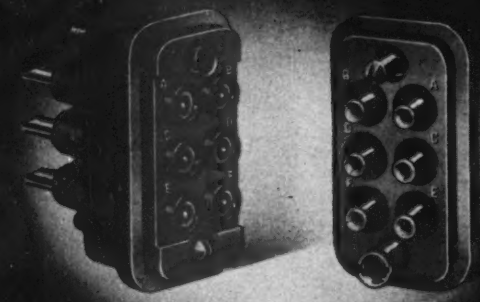
Features:

- Frequency standard accurate to one part in 10^9.
- Frequency determination accurate to ±10 kc.
- Ten mc, 1 mc, and interpolation markers available.
- Markers throughout entire frequency range, 940 mc to 2040 mc.

Polarad Electronics Corporation

100 METROPOLITAN AVE., BROOKLYN 11, N. Y. • STagg 2-3464

Winchester Electronics
INCORPORATED

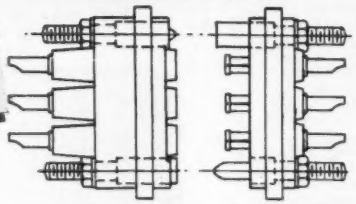


when you need special, high quality

ELECTRICAL CONNECTORS

Our "QRE" Connector series with 12, 18, 24 and 34 contacts has been expanded to include the 6-contact Connector shown above.

Diagram shows Actual Size



QRE 6-S Receptacle — QRE 6-P Plug

The following features of our "QRE" Connectors have found wide acceptance in the electronic industry:

QUICK DISCONNECTING. The separately spring loaded contacts used in these connectors eliminate the annoying prying and pulling necessary when separating ordinary multi-contact connectors. Forcing, which frequently results in serious damage, is eliminated and special levers are not required.

SELF-ALIGNING. Heavy pilots and individually floating contacts insure self-alignment and provide positive polarization.

BAYONET LOCKING GUIDE PINS (if specified) are knob or lever actuated. They eliminate accidental disengagement.

MONOBLOC* CONSTRUCTION reduces dust and moisture accumulation.

MOLDED MELAMINE BODIES provide mechanical strength as well as high arc and dielectric resistance.

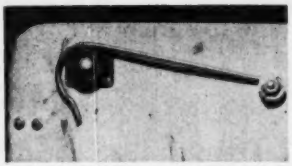
CONTACTS (#16AWG) are precision machined from brass for pin contacts and from phosphor bronze for socket contacts. They are gold flashed over silver plate to provide consistent low contact resistance, reduce corrosion and to aid in soldering.

*Trade Mark — Patent No. 2466370

WINCHESTER ELECTRONICS
INCORPORATED

GLENBROOK, CONN., U.S.A.

WRITE OR WIRE TODAY FOR FULL DETAILS



Hook for conveyor is snapped over one ball caster when pallets are in use on assembly line

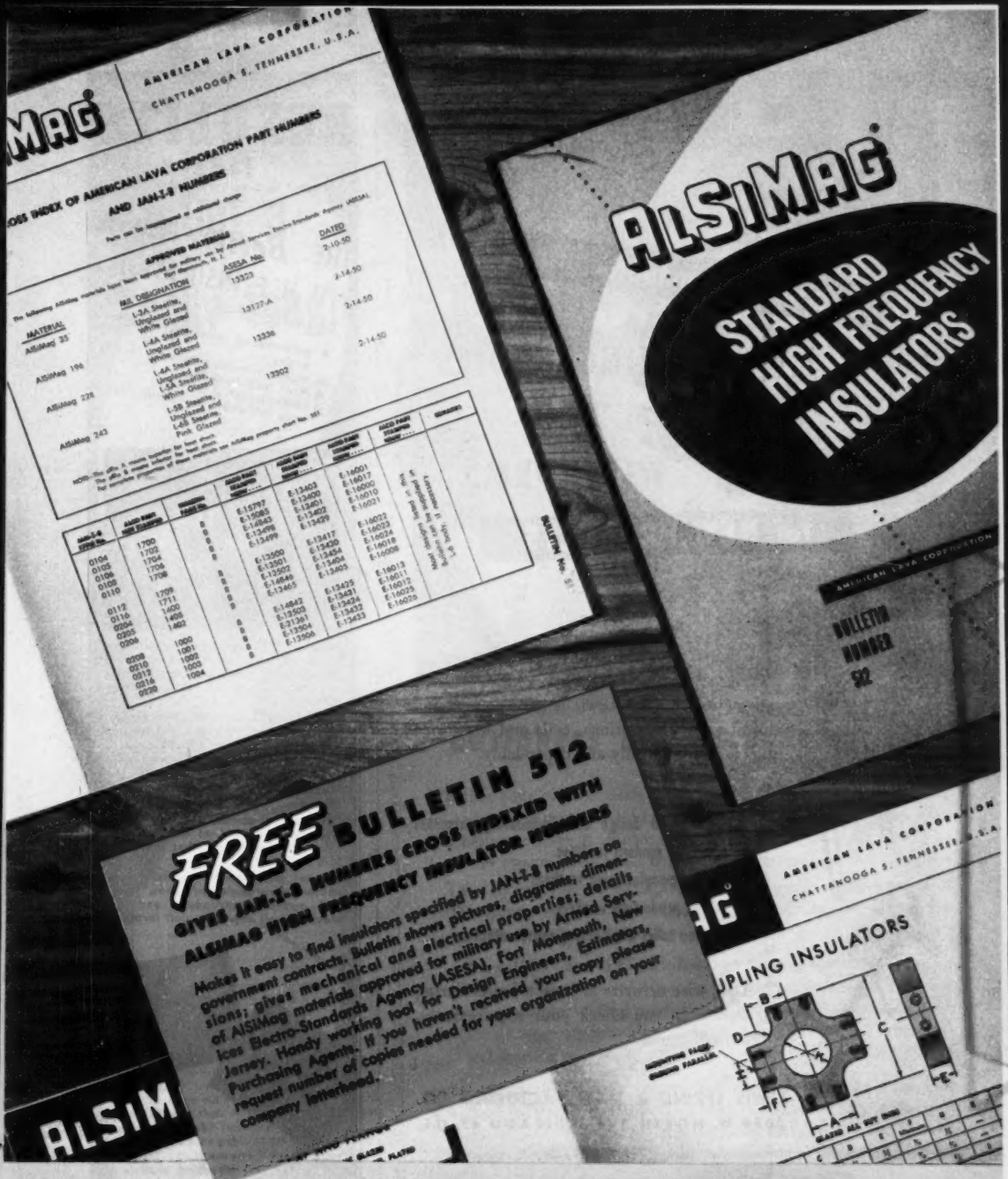
tudinal spring steel wires around which one layer of spring steel wire s close wound. A second layer of much larger wire is wound over this with turns spaced to about 4 turns per inch to form the threads for the conveyor.

After the steel channel is bent to the required curves, it is hung from the ceiling by single quarter-inch rods without cross bracing. The shaft is pushed in from one end. The shaft is driven by a ½-hp three-phase a-c motor through a belt-and-pulley speed-reducer. Maximum permissible shaft length per motor is about 150 feet if there are no bends. Up to 180 degrees total curve per length is permissible, and for this limit the length must be reduced to about 120 feet. For the total length of 240 feet, Emerson therefore uses two separately driven 120-foot shafts, with pallet hooks dropping off the end of the first shaft onto the start of the second. Load limit for this type of conveyor is about 5 lb per foot.

Similar channel-enclosed flexible threaded shaft can be recessed into assembly-line benches for moving light-weight chassis units such as tuners. Special chassis support fixtures or pallets are used, having ball casters and a member that projects downward to engage the threads on the rotating shaft. If units are sufficiently light, they can rest directly on the bench and slide along it, without casters.

Hot-Blade Wire-Stripper

WHEN rubber insulation on wires cannot be stripped conventionally, production men at RCA Victor's Camden plant use a wire burner made by Ideal Industries for burning through the insulation. The wire to be stripped is inserted between two current-heated steel-


AMERICAN LAVA CORPORATION
CHATTANOOGA 5, TENNESSEE, U.S.A.
AND JAN-I-8 NUMBERS
APPROVED MATERIALS
MIL DESIGNATION
ASESA No.
DATED
ALSIMAG
STANDARD
HIGH FREQUENCY
INSULATORS
BULLETIN
NUMBER
512
FREE BULLETIN 512
GIVES JAN-I-8 NUMBERS CROSS INDEXED WITH
ALSIMAG HIGH FREQUENCY INSULATOR NUMBERS
Makes it easy to find insulators specified by JAN-I-8 numbers on government contracts. Bulletin shows pictures, diagrams, dimensions; gives mechanical and electrical properties; details of AlSiMag materials approved for military use by Armed Services Electro-Standards Agency (ASESA), Fort Monmouth, New Jersey. Handy working tool for Design Engineers, Estimators, Purchasing Agents. If you haven't received your copy please request number of copies needed for your organization on your company letterhead.
AMERICAN LAVA CORPORATION
CHATTANOOGA 5, TENNESSEE, U.S.A.
UPLING INSULATORS
ALSIM

50TH YEAR OF CERAMIC LEADERSHIP

AMERICAN LAVA CORPORATION

CHATTANOOGA 5, TENNESSEE

OFFICES: METROPOLITAN AREA: 671 Broad St., Newark, N. J., Mitchell 2-0159 • PHILADELPHIA, 1649 North Broad St., Stevenson 4-2823
SOUTHWEST: John A. Green Co., 6815 Oriole Drive, Dallas 9, Dixon 9918 • NEW ENGLAND, 1374 Massachusetts Ave., Cambridge, Mass., Kirkland 7-6498
LOS ANGELES, 232 South Hill St., Mutual 9076 • CHICAGO, 228 North LaSalle St., Central 6-1721 • ST. LOUIS, 1123 Washington Ave., Garfield 4959

A Specialty of ours...

designing and manufacturing

SPRINGS, COILS AND WIREFORMS

for **NEW PRODUCTS**

BRING your spring problems to us and be assured of unusual assistance and guaranteed satisfaction . . . for Lewis is geared to design and manufacture springs, coils and wireforms quickly, economically and dependably.

Lewis offers:

- Experienced design and engineering personnel
- Extensive modern facilities
- Unique manufacturing methods
- Skilled production workers
- Veteran sales engineering representatives

Call, wire or write to have a Lewis Spring Engineer help you check your requirements, without obligation.

LEWIS SPRING & MANUFACTURING CO.
2656 W. NORTH AVE., CHICAGO 47, ILL.

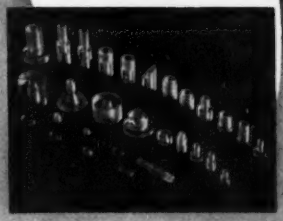
Lewis PRECISION SPRINGS

THE FINEST LIGHT SPRINGS AND WIREFORMS OF EVERY TYPE AND MATERIAL

REXOLITE
1422
(FORMERLY C. E. TEXTOLITE 1422)

THE *Better* PLASTIC
U. H. F. INSULATION
BECAUSE OF:—

- outstanding electrical properties
- superior machinability
- high heat resistance
- dimensional stability
- and extremely low initial cost



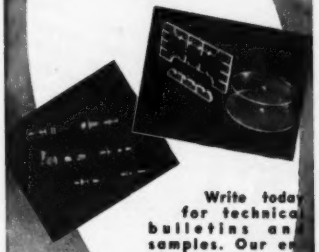
Rexolite 1422 has been specifically designed and developed to meet the growing need for a lightweight — low cost U. H. F. insulating material.

Rexolite 1422 is available for immediate delivery as centerless ground rod in any diameter up to 1". Also cast in larger diameter rods and sheets.

Meets JAN-P-77 and MIL-P-77A specifications.

The unusual chemical inertness and physical properties of Rexolite 1422 allow its use where other materials fail.

For use in: connectors, coaxial connectors, waveguide, antennas, leads and spacers, spreaders and air wound coil supports, coil forms.

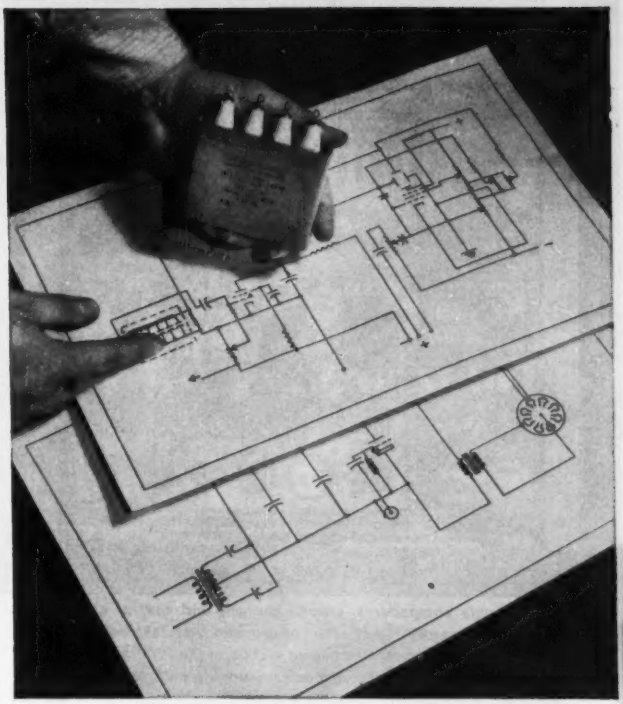


Write today for technical bulletins and samples. Our engineering staff is always at your disposal.

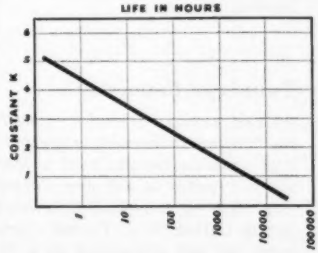
Manufacturers of Non-strip wire, High Temperature Electrical Tubing and other extruded plastic products.

THE REX CORPORATION
66 LANSDOWNE STREET
CAMBRIDGE 39, MASS.

Got a really tough capacitor network problem for us?



...let our network designers help you solve it!



This curve results from actual life tests of capacitor networks under pulsing conditions in a radar modulator. Service life, for varying values of "K", starts at 2 tenths of one hour and stretches out to something over 40,000 hours (more than 4½ years of continuous operation at full-rated voltages.)

It's just one example of actual performance data G-E engineers use in designing capacitor networks for the job they must do.

Whether your problem deals with guided missiles—aircraft—land or sea radar equipments, General Electric application and design engineers can help you solve it. We've designed and built capacitor networks for every type of pulse radar equipment since the inception of radar.

Take service life for example. You can specify a service life of 10,000 hours—or just 60 seconds. And we'll deliver pulse networks to match your requirements. Here's why:

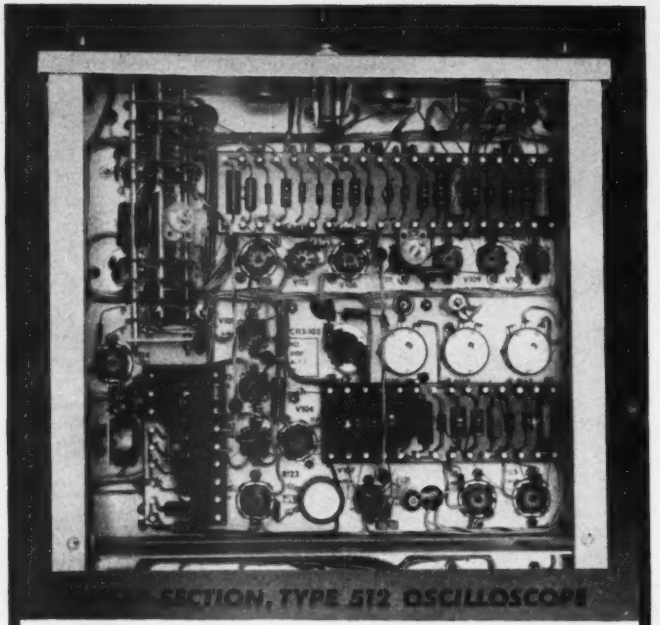
> Since 1944 General Electric has been running continuous life tests on many types of networks. We've established life limitations, under varying conditions of temperature and voltage, for all types of dielectrics, bushings, materials for coil forms and treating processes.

Let us use this store of information and experience to solve your capacitor network problems. Your inquiry addressed to your nearest Apparatus Sales Office, or to Capacitor Sales Division, General Electric Company, Hudson Falls, N. Y. will receive prompt attention.

General Electric Company, Schenectady 5, New York.

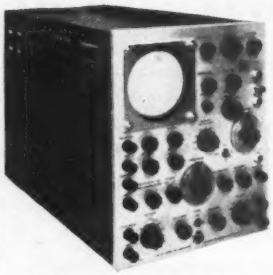
GENERAL ELECTRIC

407-308



SECTION, TYPE 512 OSCILLOSCOPE

High quality components, careful design, and special care in manufacture insure the quality construction that Tektronix users have learned to expect. The sweep section of the Type 512 Oscilloscope pictured above illustrates the planning and workmanship that help make this instrument a top performer with a reputation for trouble-free service.



- **Band Pass—dc to 2 mc**
- **Sensitivity—5 mv/cm maximum**
- **Sweeps—.3 sec/cm to 3 μsec/cm**

(1 sec/cm or 3 sec/cm available on special order)

Ideal for projects requiring high sensitivity, slow sweeps, and single, triggered sweeps, the Type 512 is also regarded as an excellent general purpose oscilloscope. Features like accurate sweep time and amplitude measuring facilities, differential vertical amplifier, automatic carrier type blanking permitting the use of very slow triggered sweeps, and regulation of all dc voltages make the Type 512 the preferred oscilloscope for all work within its sweep and frequency capabilities.

Tektronix Type 512 Cathode-Ray Oscilloscope
$950.00 f.o.b. Portland, Oregon

COMPLETE SPECIFICATIONS ON REQUEST

TEKTRONIX, Inc.

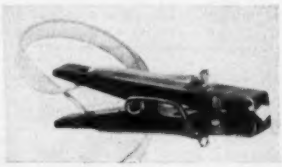
P. O. Box 831-A, Portland 7, Ore. • Cables: Tektronix

Using heat to strip rubber-covered insulation from wire. Stripped insulation drops into drawer below. Rheostats permit independent control of current through each heating jaw

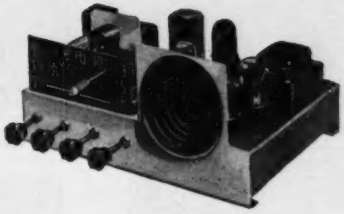
copper alloy jaws until an adjustable back-stop is touched by the wire. A foot pedal is then pressed, bringing the hot jaws together. Usual time to cut through the insulation with heat is less than 1 second. The wire is then pulled out while jaws are still closed, stripping it clean. Heating jaws have U-shaped indentations like conventional wire-stripping blades, eliminating need to rotate wire during heating.

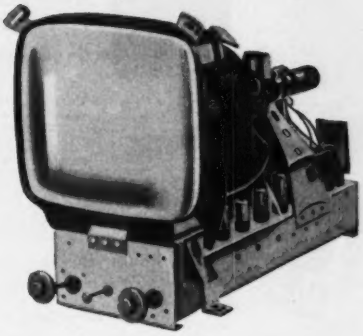
Twin-Lead Connector

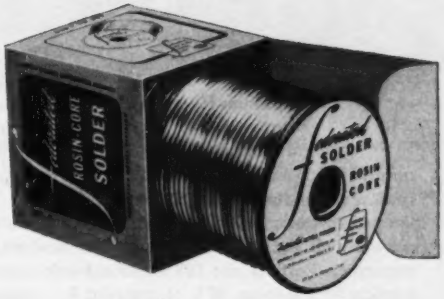
AS FAST as any fixture for connecting 300-ohm twin-lead line to screw-type antenna terminals of a television receiver is the new Tenna-Clip made by Industrial Television Inc. in Clifton, N. J. During alignment and test operations on a receiver production line, an operator can connect or disconnect the antenna just as fast as if making a



Clip permits connecting two wires to two adjacent terminals quickly

FOR RADIO  AND

TV  SOLDERING THAT LASTS...

USE... 

For any soldering job that demands freedom from corrosion and conductive flux residue . . . for ease of working and unequalled consistency . . . there is nothing better than Federated Rosin Core Solder.

Each Rosin Core Solder composition . . . there is a variety for different purposes . . . is a tin and lead alloy with a rosin flux that is effective but not corrosive. Because the rosin residue is chemically inactive, current leakage at radio and television frequencies is prevented.

Federated Rosin Core Solder is a quality product that is unsurpassed for the permanence of the bond it produces . . . for the consistently easier soldering job it does! Look for it in 1, 5, 20, 25, and 50-pound sizes on the familiar orange and black metal spool. Listed by Underwriters' Laboratories Inc.

Federated Metals Division

Federated first in the non-ferrous field. AMD

AMERICAN SMELTING AND REFINING COMPANY • 120 BROADWAY, NEW YORK 5, N. Y.

Zirconium Hydride applied by spraying or cataphoretic precipitation presents the advantage of protecting the Zirconium against oxidation at lower temperatures during seal-in or exhaust. Fired in vacuum, at higher temperatures its hydrogen is completely given off reducing all traces of adsorbed oxygen and other impurities. Particle size 100%-325 sub-seive, average particle 5±1 micron, 80% of material 3±1 micron. Relatively inert, Zirconium Hydride is shipped dry. May be suspended in commonly accepted binders such as cellulose-acetate and pyroxylin resins.

Zirconium metal powder, finely divided, may be sprayed for coating tube parts, suspended in temporary binders such as nitro cellulose dissolved in amyl acetate.—Shipped wet.

For more complete details, request Bulletins 700A and 701A or submit your problem for the recommendations of our research and engineering departments.

METAL HYDRIDES INC

12-24 CONGRESS STREET • BEVERLY • MASS.

See Us at the IRE Show—Booth 223

BEAM
for quality products

Cossor Double Beam Precision Oscillographs

Model 1035 General Purpose Instrument

- Double beam C.R.T., flat 90 mm screen.
- Time base has directly calibrated time scale. 15 microseconds — 150 milliseconds in 9 ranges. Repetitive or triggered operation, internal or external synch. by selection, suppressed fly-back, calibration waveform provided.
- Y1 Amplifier. Response 7 mcs. to 20 c.p.s. directly calibrated voltage scale with 7 ranges.
- Y2 Amplifier. 100 Kcs. to 20 c.p.s. directly calibrated voltage scale with 5 ranges.
- All necessary circuitry accessible on front or side panels.

Model 1049 Oscillograph with D.C. Amplifiers

- Double Beam flat face C.R.T. 90 mm dia.
- Time base. Directly calibrated time scale, response 150 microseconds to 1.5 seconds in 9 ranges. Internal or external synch., repetitive, triggered or single stroke T.B. operation, by selection.
- Y1. D.C. Amplifier. D.C.—100 Kcs., with directly calibrated Y shift control. Gain 900.
- Y2. D.C. Amplifier. Calibrated switch attenuator for Y2 sensitivity. Gain 25.
- Beam Trigger operation facilities, off, electrical and time marking, mechanical sources and from power supply or push button.
- All necessary circuitry accessible on front or side panels.

MODEL 1037 (Portable). A general purpose double beam oscillograph. Y1 amplifier direct coupled. Y2 amplifier A. C. connected.
Power supply: **30-230 VOLTS INPUT AT ANY FREQUENCY FROM 25 TO 2400 CYCLES.**
MODEL 1428 — Camera. Manual or power driven.
MODEL 1429 — Motor drive for camera.
MODEL 1430 — D. C. amplifier. (Trolleys and usual accessories available.)

Vacuo Junctions (Thermocouples)

Best Products.
U.H.F. Types — 5 MA. to 1000 MA.
Standard Types — 1.25 MA. to 1000 MA.

Wires and Cables

"A full range of "Sterling" wires and cables for Television including coaxials and TV camera cables, Radio and Communications and Multi-conductor cables, also insulated power wires and electrical cables."

All above products available from stocks or for early delivery without priority ratings or allocations.

See Your Jobber or write for complete descriptive literature to:

BEAM INSTRUMENTS CORPORATION
350 Fifth Avenue New York 1, N. Y.
Tel. LOngacre 5-0522

SONAR

by Edo

THE WAKES... of more and more vessels churn over water accurately scanned by Edo sonar. A major electronic development in underwater detection equipment, Edo sonar will measure depths over far greater ranges with accuracy, clarity and legibility never before achieved.

Because of such development work in its electronics laboratories, Edo has become a major supplier of sonar equipments for the United States Navy.

EDO CORPORATION College Point, L.I., N.Y. SINCE 1925

DO YOU MAKE FERRITES?

If so, you'll be well repaid by getting the facts on a special group of Pure Ferric Oxides, developed by Williams and manufactured especially for this purpose.

Williams Ferric Oxides analyze better than 99% Fe_2O_3. They contain a minimum of impurities. They are available in a broad range of particle sizes and shapes. Among them, we're certain you'll find one that's "just right" for your requirements. The proper application of Ferric Oxides to the manufacture of Ferrites is our specialty. So write today, stating your requirements. We'll gladly send samples for test. Chances are good that our Ferric Oxide "Know How" can save you considerable time and money. Address Department 25, C. K. Williams & Co., Easton, Pennsylvania.

WILLIAMS
COLORS & PIGMENTS

C. K. WILLIAMS & CO.

Easton, Pa. • East St. Louis, Ill. • Emeryville, Cal.

single clip connection. Metal jaws are attached to a spring-type clothespin and each jaw is connected to one of the twin-lead conductors.

Assembly-Line Merry-Go-Rounds

A SMALL angle-mounted turntable speeds assembling and soldering of parts on ten pairs of sockets at a time during production of X-ray diffraction instruments at the Mount Vernon, N. Y. plant of North American Philips Co.

Ten pairs of inverted tube bases are screwed to individually rotatable wood discs on the all-wood rotating turntable to serve as holders for the sockets. Mounting and soldering of small parts and short leads has proved much easier when done before the sockets are riveted in place deep in a crowded chassis. Errors are cut to a minimum by adding the same part or lead to each of the ten subassemblies in turn as the platform is turned.

Cabinet Merry-Go-Round

A large four-position turntable holds four console television cabinets at convenient working height for installation of speakers and loop antennas at the Brooklyn plant of CBS-Colubia. Fastened on top of the table at each position is a rectangular frame of 2-by-4's covered with several thicknesses of sponge

Subassembly merry-go-round at North American Philips Co. holds ten pairs of sockets. Each pair is on a pivoted wood disc that can also be turned

Lapp

PLUG-AND-RECEPTACLE for Sectionalizing Circuits

SIMULTANEOUS contact of any number of leads can be made or broken by use of Lapp Plug-and-Receptacle units, for panel-rack assembly or other sectionalized circuits. Insulation is Steatite, the low-loss ceramic which is non-carbonizing, even when humidity, moisture or contamination sets up a leakage path. The unit shown above provides twelve contacts, rated for operation at 2.5Kv peak terminal-to-terminal, 1.5Kv peak terminal-to-ground, 25 amps at 60 cps. All contacts are silver-plated; terminals are tinned for soldering. Polarizing guide pins assure positive alignment. Write for specifications of this and other available units, or engineering recommendations for special units for your product.

Lapp Insulator Company, Inc., LeRoy, New York

Lapp

STANDARD
Radio Interference and Field Intensity
MEASURING EQUIPMENT

Complete Frequency Coverage -- 14kc to 1000mc!

NM - 10A *VLF*

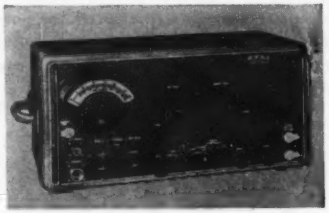
14kc to 250kc
Commercial Equivalent of AN/URM-6.
Very low frequencies.

HF **NM - 20A**

150kc to 25mc
Commercial Equivalent of AN/PRM-1. Self-contained batteries. A.C. supply optional. Includes standard broadcast band, radio range, WWV, and communications frequencies.

NMA - 5A *VHF*

15mc to 400mc
Commercial Equivalent of TS-587/U.
Frequency range includes FM and TV Bands.



UHF **NM - 50A**

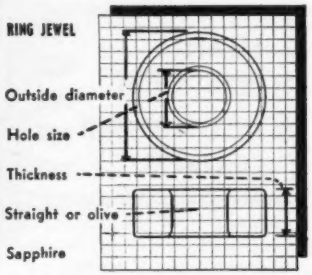
375mc to 1000mc
Commercial Equivalent of AN/URM-17.
Frequency range includes Citizens Band and UHF color TV Band.

These instruments comply with test equipment requirements of such radio interference specifications as JAN-I-225a, ASA C63.2, 16E4(SHIPS), AN-I-24a, AN-I-42, AN-I-27a MIL-I-6722 and others.

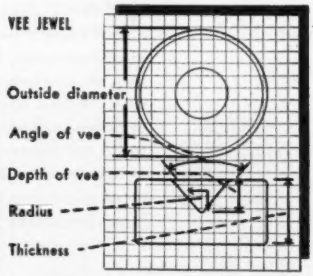
STODDART AIRCRAFT RADIO CO.
6644 SANTA MONICA BLVD. HOLLYWOOD 38, CALIFORNIA
Hillside 9294

ORDER Jewel Bearings from Bird TO YOUR SPECIFICATIONS

Bird's engineering staff has the answers to your Jewel Bearing needs. Jewels of any size can be furnished to exact tolerances . . . either unset or set in screws or bushings of your design, ready for assembly into your product without further inspection. Shown below are just two of the many types of Jewel Bearings — precision manufactured by Bird — outlining dimensions needed for ordering. A simple sketch incorporating these specifications will help us to furnish . . . more quickly . . . more accurately, a quotation and delivery of the *right* Jewel Bearing to help you build quality into your product.
Performance proved for precision and long life.



Polish hole Polish faces
Specify tolerances



Sapphire or glass Polish faces
Specify tolerances

The engineering staff of the Bird Company is at your service for all small bearing problems.

Serving industry with fine jewels since 1913

Richard H. Bird & Co., Inc.
Sapphire and glass jewels ● Precision glass grinding
Ferrite precision products ● Sapphire stylii
1 Spruce Street, Waltham 54, Mass.

Custom STYLE AND QUALITY AT *Standard* COST

RAYTHEON® STANDARD CONTROL KNOBS

Excellence in Electronics

Choose control knobs for your finest electrical or electronic equipment from this complete family of sizes and functional types. You get integrated design and distinctive styling . . . without the high cost of custom tooling. Made of tough, durable "Tenite II" (cellulose acetate butyrate), injection molded with anodized aluminum inserts and dual setscrews. Black knobs available with high gloss "mirror" finish for commercial applications or non-reflecting "matte" finish for government equipments. Manufacturers interested in colored knobs are invited to submit their requirements for quotation.

Write For Complete Information
Address Dept. 6470 KA

ALL IN MATTE OR MIRROR FINISH

RAYTHEON MANUFACTURING COMPANY
Equipment Sales Division • Waltham 54, Mass.

DISTRICT OFFICES: BOSTON, NEW YORK, CLEVELAND, CHICAGO, NEW ORLEANS, LOS ANGELES (WILMINGTON), SAN FRANCISCO, SEATTLE
INTERNATIONAL DIVISION: 19 RECTOR STREET, N. Y. C.

Guthman
Coils
for those who put QUALITY first!
edwin i. guthman & co., inc.
15 s. throop st. chicago 7. . CH 3-1600
also attica, indiana .
BURTON BROWNE ADVERTISING

Cabinet merry-go-round used in place of conveyor line at CBS-Columbia when only a few cabinet operations are needed

rubber, to protect the finish when the cabinet is handled upside-down. Three positions serve for three different series of assembly operations, and the fourth position serves for loading and unloading the cabinets.

The cabinet turntable is constructed from wood, with a vertically mounted pipe serving as pivot. Eight fixed rubber-wheel casters mounted on a four-foot diameter under the turntable roll on the plywood sub-table to take the weight of the merry-go-round.

Counter Merry-Go-Round

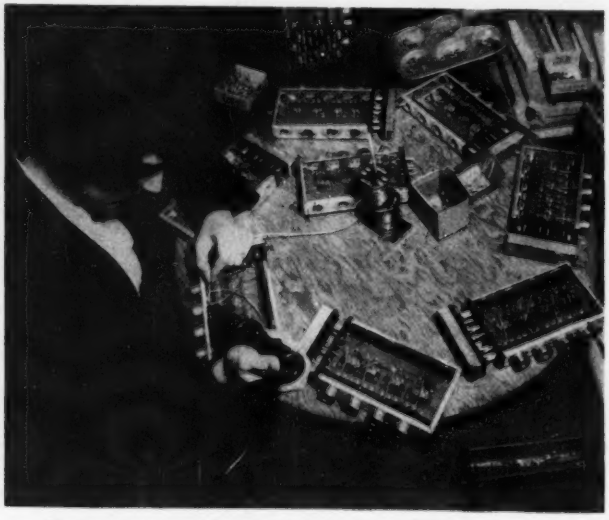
Plug-in electronic counter units are assembled seven at a time on a half-inch plywood merry-go-round in the Great Neck, Long Island plant of Potter Instrument Co. Mating sockets for the plug-in terminals are mounted on wood strips that are hinged to the turntable, to serve as holding fixtures for the chassis units and still permit turning over the chassis units quickly for work on the opposite side.

The projecting shaft of the turntable is a convenient holder for solder and wire spools. As in all merry-go-round assembly work, the same short cycle of operations is performed on each chassis in turn as the table is spun around, to take advantage of accuracy and speed gained through repetition of simple operations.

Pass-Along Merry-Go-Round

A merry-go-round assembly line is used by the Crosley Division of Avco Mfg. Corp. to maintain quality during excessively long operator cycles involved in low-quantity production of complicated electronic equipment. Chassis wiring operations are broken down to approximately one-minute cycles and the work for each such cycle is listed on a 3 by 5-inch card.

Operators sit on both sides of a long work table having raingutter-type parts trays down the full length of each side. The chassis

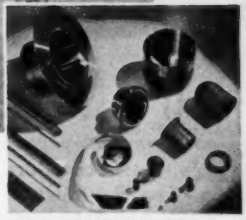


Merry-go-round assembly of electronic counters at Potter Instrument Co.

Your sealed assemblies can be kept TIGHT with

STUPAKOFF Kovar-Glass Seals

Stupakoff Metal-to-Glass Seals are made in a variety of sizes and ratings.



Kovar Metal, the ideal alloy for glass sealing, is furnished in the form of tubes, rods, sheet, foil and fabricated shapes.

Metal-to-glass seal making has been highly perfected by Stupakoff. When you specify Stupakoff Seals, you get well-designed, accurately-made products that are easy to assemble, mechanically strong, have high flashover ratings, provide high resistance to thermal shock and are dependable. They are made in a wide variety of standard types and sizes, or in special designs to meet your specific needs.

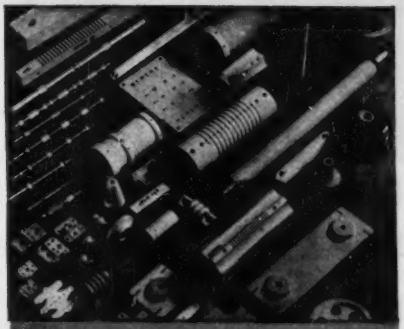
Stupakoff seals are all made with Kovar Metal, which is readily bonded with hard glass producing no undesirable structural stresses. It has substantially the same expansitivity as hard glass from -80°C to the annealing point of glass. These characteristics of Kovar make Stupakoff Seals dependable.

Write for samples and prices of typical Stupakoff Kovar-Glass Seals.

STUPAKOFF

CERAMIC & MANUFACTURING COMPANY

Latrobe, Pennsylvania



Representative Stupakoff Ceramic products.

STUPAKOFF PRODUCTS

For Electrical and Electronic Applications

ASSEMBLIES—Metallized ceramic induction coils and shafts; metallized plates for fixed rigid assemblies; ceramic trimmer condensers.

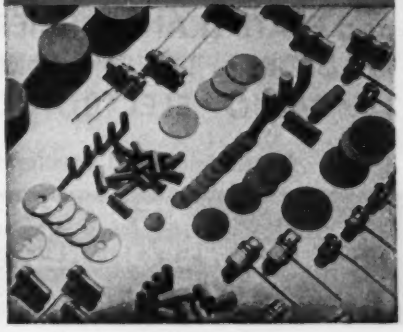
CERAMICS—Stupakoff has long been a leading supplier of ceramic products for a wide variety of electrical and electronic applications—precision made for all voltages, frequencies and temperatures.

RESISTOR CERAMICS—Used for temperature indicating or measuring equipment such as Radiosonde, for infra-red light source and for heating elements. Complete with terminals, in the form of rods, tubes, discs, bars, rings, etc.

STUPALITH—A group of ceramics having remarkable ability to withstand extreme thermal shock. STUPALITH may be made to have zero, low-positive or low-negative expansitivities. Formed by conventional methods. Safely used at temperatures up to 2200 degrees Fahrenheit.

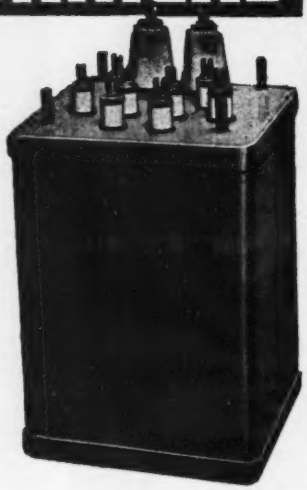
CERAMIC DIELECTRICS—For by-pass, lead through, blocking, standoffs and trimmer applications. Temperature compensating Ceramic Dielectrics have coefficients from P-100 to N-2700, and high K materials up to K-6000. Tubes, discs and special shapes, plain or silvered.

PRINTED CIRCUITS—Complete electrical circuits including resistors and capacitors of precision values combined in one sturdy, compact unit. For amplifiers, couplings, filters, integrators.



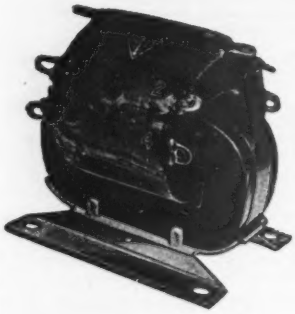
FULL RANGE OF MIL-T-27 TRANSFORMERS

HERMETICALLY SEALED UNITS



NYT hermetically sealed transformers are available in all standard sizes to meet MIL-T-27 specifications, and especially designed constructions for a wide variety of military as well as civilian applications. Designed and built to meet the most exacting specifications. Production facilities for quantity production of all sizes.

the HORNET



HORNET transformers, pioneered by NYT, are of open type construction, utilizing Class H insulating materials. Approximately one-fourth the size and weight of comparable Class A units. Filament and plate supply transformers and chokes. Units can be designed for ambients up to 190 deg. C., altitudes up to 60,000 feet; power ratings from 2VA to 5KVA.

POWER, AUDIO, FILAMENT and PLATE TRANSFORMERS
REACTORS • FILTERS • CHOKES
TV • RADIO • ELECTRONICS

NYC

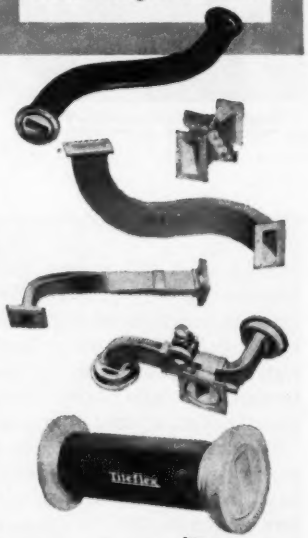
Engineering and development facilities

NEW YORK TRANSFORMER CO., INC.
ALPHA, NEW JERSEY

Titeflex
has the experience
in

WAVEGUIDES COMPONENTS ASSEMBLIES

Regardless of the types of waveguides and components you require, Titeflex can supply them. We manufacture rigid and flexible guides, combinations of the two, and any required component parts. As an A-N approved source, our engineering and testing facilities are always available for the development of new designs. Write us.



SEND FOR THIS *NEW BULLETIN*

Contains complete waveguide specifications, including materials, dimensions and recommended operating ranges for all types.

Titeflex, Inc.
524 Frelinghuysen Ave., Newark 5, New Jersey

What kind of men?

What kind of men are the 2500 scientists and engineers of Bell Telephone Laboratories?

They are men of many types, yet they work well together, for all have good minds as a foundation, years of study in the fundamentals of their science and in the methods of research and design. Vital, too, is their teamwork — for without the co-operation of many individuals the products of research and development could never be perfected.

Above all else these men have "the spirit to adventure, the wit to question, and the wisdom to accept and use."

Such men can develop the world's finest telephone systems — and have done so.

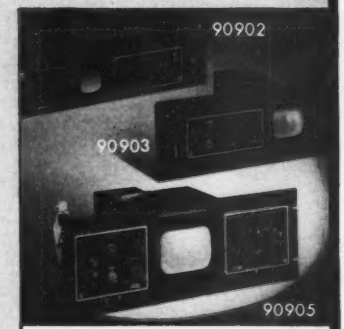
Perhaps there is a place among them for you. Write the Employment Director, Bell Telephone Laboratories, New York 14.

BELL TELEPHONE LABORATORIES

• EXPLORING AND INVENTING, DEVISING AND PERFECTING FOR CONTINUED IMPROVEMENTS AND ECONOMIES IN TELEPHONE SERVICE

Designed for

Application

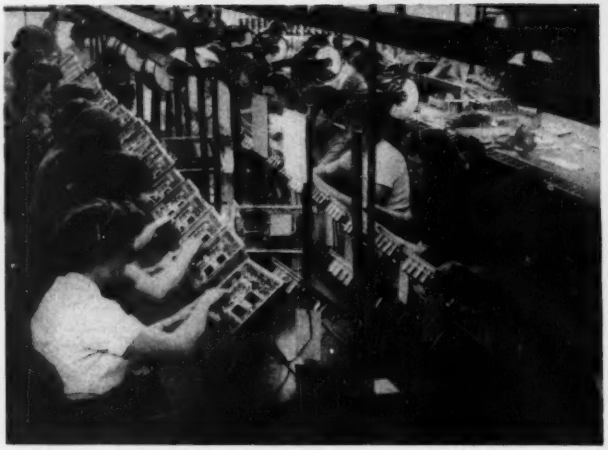


90900 Series
Cathode Ray Oscilloscopes

The No. 90902, No. 90903 and No. 90905 Rack Panel Oscilloscopes, for two, three and five inch tubes, respectively, are inexpensive basic units comprising power supply, brilliancy and centering controls, safety features, magnetic shielding, switches, etc. As a transmitter monitor, no additional equipment or accessories are required. The well-known trapezoidal monitoring patterns are secured by feeding modulated carrier voltage from a pickup loop directly to vertical plates of the cathode ray tube and audio modulating voltage to horizontal plates. By the addition of such units as sweeps, pulse generators, amplifiers, servo sweeps, etc., all of which can be conveniently and neatly constructed on companion rack panels, the original basic 'scope unit may be expanded to serve any conceivable industrial or laboratory application.

JAMES MILLEN MFG. CO., INC.

MAIN OFFICE AND FACTORY
MALDEN
MASSACHUSETTS



Merry-go-round pass-along assembly line used by Crosley. Each chassis goes down one side of table, across end, up other side, across end, then around again as many times as necessary to complete all the one-minute cycles of work

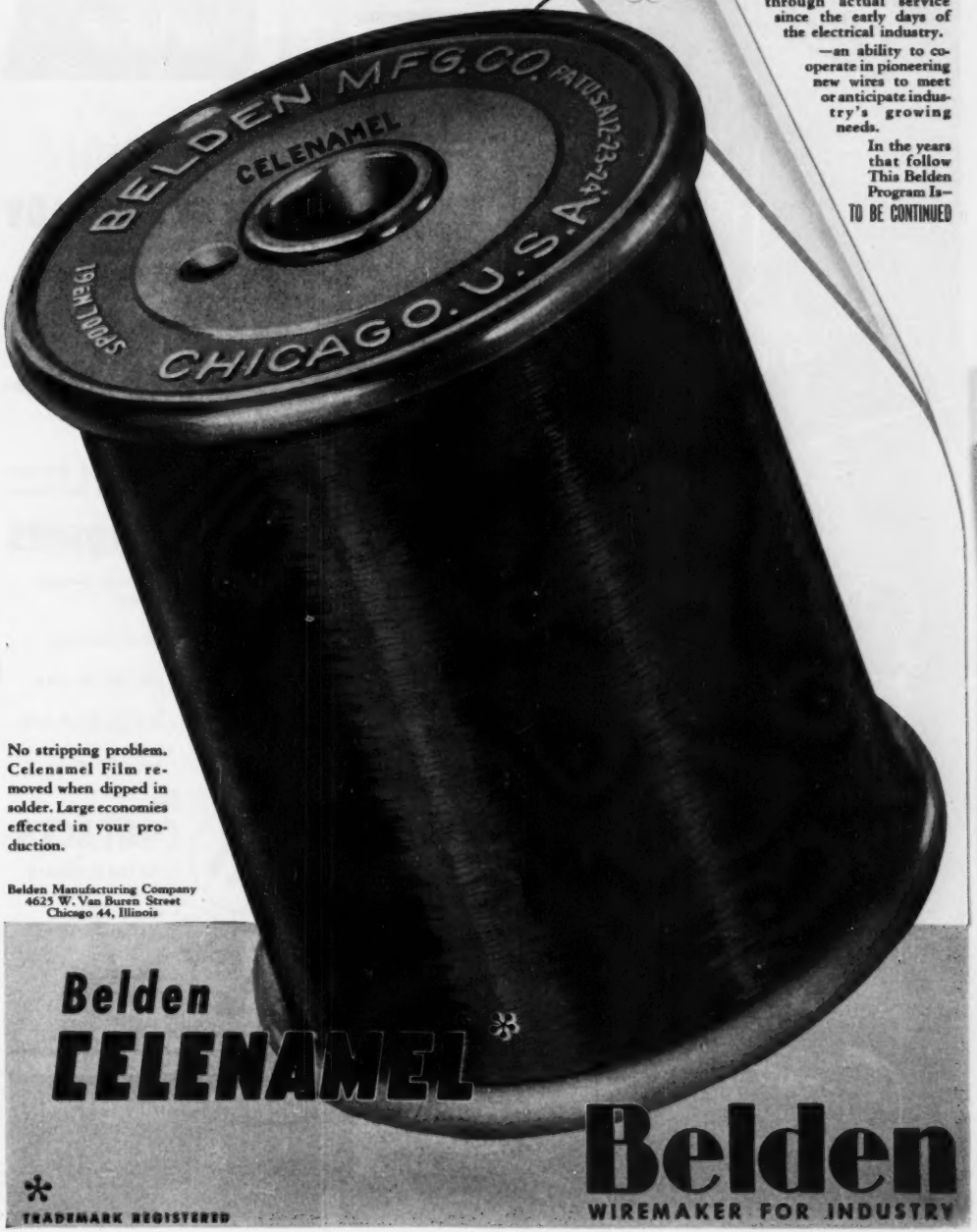
units are delivered to this table with all large items such as chokes, transformers, coils and riveted parts already mounted. Each chassis is on a fixture that holds it at an angle facing the operator and permits easy sliding on the table.

Operation of the merry-go-round is best illustrated by a specific example. Assume that fifty units are to be produced and 20 operators are available. At one-minute intervals, a load of 50 riveted chassis units from subassembly is fed to operator No. 1. She does operation No. 1 on each chassis and slides it on to the next operator for the next one-minute cycle of work. Fifty minutes later the merry-go-round assembly line is full and operator No. 20 is finishing operation No. 20 on chassis No. 1, whereas operator No. 1 is finishing her work on the 50th and last chassis of the run. When

Self-service parts supply cart used in conjunction with Crosley merry-go-round production line. Cart is loaded in stockroom with quantities to match single day's production, giving close control of material. Each operator takes from the cart the individual filled trays she will need, and places them in the rainguiter-type holder that runs the full length of the work table. Ball-caster chassis jacks are used on this particular line

HERE'S THE WIRE THAT CUTS YOUR PRODUCTION COSTS

FOR 50 YEARS Wiremaker for Industry



To You,

Belden's Golden Anniversary Means

—product performance that can come only from a "know-how" that has grown through actual service since the early days of the electrical industry.

—an ability to cooperate in pioneering new wires to meet or anticipate industry's growing needs.

In the years that follow This Belden Program Is—

TO BE CONTINUED

No stripping problem. Celenamel Film removed when dipped in solder. Large economies effected in your production.

Belden Manufacturing Company
4625 W. Van Buren Street
Chicago 44, Illinois

Belden

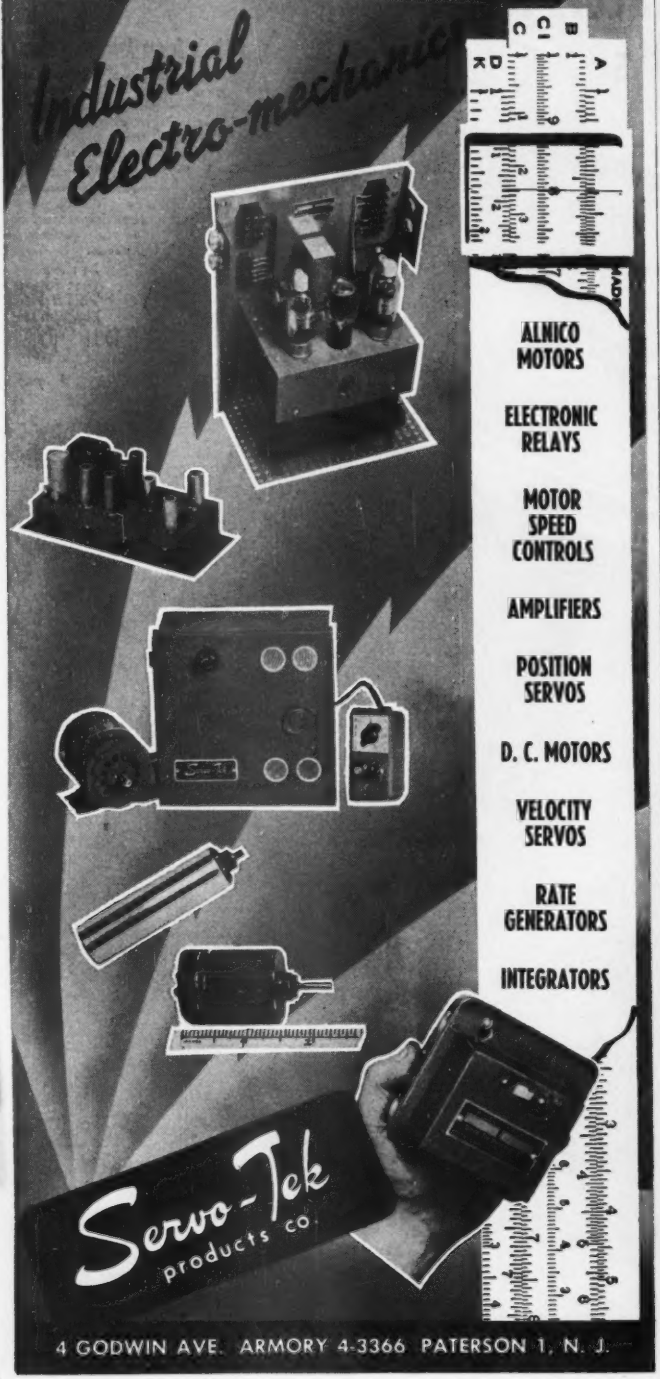
CELENAMEL *

* TRADEMARK REGISTERED

Belden

WIREMAKER FOR INDUSTRY

Industrial Electro-mechanics



ALNICO MOTORS

ELECTRONIC RELAYS

MOTOR SPEED CONTROLS

AMPLIFIERS

POSITION SERVOS

D. C. MOTORS

VELOCITY SERVOS

RATE GENERATORS

INTEGRATORS

Servo-Tek products co.

4 GODWIN AVE. ARMORY 4-3366 PATERSON 1, N. J.

Where the Requirements are Extreme...

Use SILVER GRAPHALLOY

For extraordinary electrical performance

GRAPHALLOY

THE SUPREME BRUSH AND CONTACT MATERIAL

for BRUSHES

- for high current density
- minimum wear
- low contact drop
- low electrical noise
- self-lubrication

for CONTACTS

- for low resistance
- non-welding character

*Graphalloy is a special silver-impregnated graphite

Accumulated design experience counts — call on us!

GRAPHITE METALLIZING CORPORATION

1055 NEPPERHAN AVENUE, YONKERS 3, NEW YORK

YOU ARE LOOKING AT
THE MOST Accurate and MOST Rugged
TIME-MEASURING INSTRUMENT IN GENERAL USE
IN THE WORLD!

The STANDARD PRECISION TIMER

It's There — in the "Clutch"
the Heart of STANDARD'S
Uncanny Precision
Performance

WE MEASURE ELAPSED TIME DOWN TO INTERVALS OF 1/1000th SECOND

Available in 12 Models

Manually and Electrically Operated
•
Portable Cases or Panel Mounting
•
Optional Changes to Conform to Customers' Requirements

Government
Educational Institutions
Electrical Industries
Scientific Laboratories
Aviation
Automotive
Chemical
Food
Textile
Paper
Petroleum
Hundreds of Other INDUSTRIAL Classifications

Let our Engineers help you with Your Special Timing Problems

WRITE for

ESTABLISHED 1884
STANDARD
ELAPSED TIME — SIXTY-EIGHT YEARS

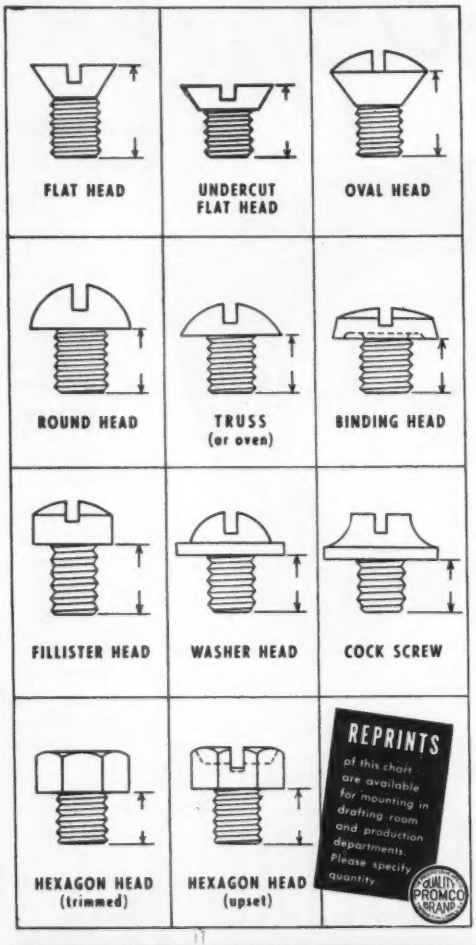
THE STANDARD ELECTRIC TIME COMPANY
97 Logan Street, Springfield 2, Massachusetts
TIMERS AND CHRONO-TACHOMETERS
LABORATORY PANELS
PROGRAM CLOCK SYSTEMS
PIPELINE ANALYZERS

SAVE DRAFTING TIME

Right Way to

MEASURE MACHINE SCREWS

By dimensioning and naming machine screws as indicated, you avoid misunderstanding, cut down on drawing changes and save time in purchasing.



MACHINE SCREWS AND SPECIAL FASTENERS ARE OUR BUSINESS

WRITE FOR OUR CATALOG

THE PROGRESSIVE MANUFACTURING COMPANY

50 NORWOOD ST., TORRINGTON, CONN.

the line is starting, some operators are idle or doing other work until the first chassis reaches them, just as in any other sequential assembly line.

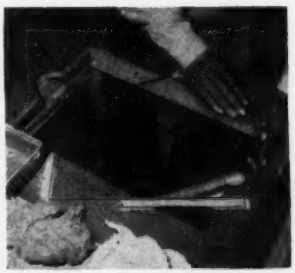
Operator No. 1 now changes to the work card for operation No. 21 and performs the specified new operations as Operator No. 20 passes the 50 units to her across the table one by one for their second trip around the table. This procedure is continued until all work has been performed on all 50 units. If it is desired to continue production beyond 50 units, a new chassis may be fed into the line as each completed chassis is removed from the last line position.

Since the operations are simple and are printed on cards passed out by instructors each time a merry-go-round line is started, the line can operate with less than 20 girls whenever there are absentees. With 50 units on the table once the line is full, one or more units are between operators to even out the cycle of work.

Advantages of the technique include shorter training time for each operator, easing of absentee problem and faster improvement in quality and output when starting a new production line. These advantages in turn give lower production costs, easier line balance, improved quality and reduced scrap.

Cleaning Safety Glass

SAFETY-GLASS windows for television receivers are cleaned with denatured alcohol while the glass is resting on a felt-covered frame over a fluorescent lamp, to highlight all spots and smears requiring removal. Fine steel wool is used



Safety glass rests on felt-covered frame of light box during cleaning

NEW! FOR VHF-UHF...

PRD TYPE 907 sweep frequency generator

FREQUENCY RANGE:
35 TO 900 MEGACYCLES

•

MINIMUM OUTPUT VOLTAGE:
1 VOLT

•

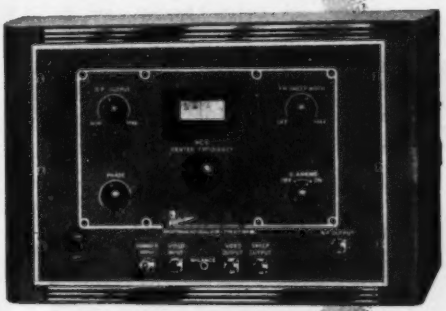
DIRECT READING FREQUENCY DIAL:
CONTINUOUSLY VARIABLE

•

OUTPUT IMPEDANCE:
75 OHMS-BNC CONNECTOR

•

MINIMUM SWEEP WIDTH ABOVE 60 MC/S:
20 MC/S

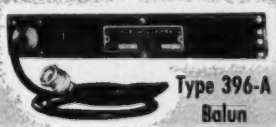


The Type 907 is a fundamental oscillator which can be swept in frequency over a band of not less than 10 mc/s for a center frequency of 35 mc/s. The sweep width is greater than 20 mc. for carrier frequencies above 60 mc/s. Output is continuously variable over a voltage range of 10 microvolts to 1 volt. Internal blanking circuits provide a "true zero" base line for an oscilloscope display.

For further information concerning this instrument and additional UHF-VHF equipment, address inquiries to Dept. E1, or visit us at the IRE Show, Booths 268-269.

Polytechnic RESEARCH & DEVELOPMENT COMPANY · Inc

55 JOHNSON ST., BROOKLYN 1, N. Y.



Type 396-A Balun

Balance-Unbalance Transition

provides a low VSWR transition between 50 ohm unbalanced to 300 balance transmission line over a frequency range of 470 to 890 mc/s.

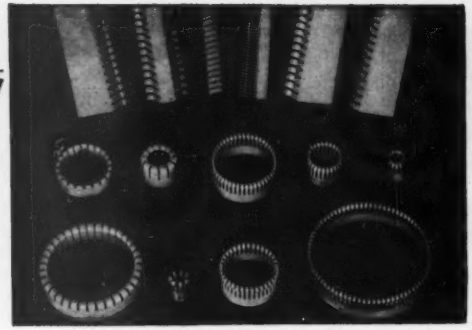
Type 904 VHF-UHF Noise Generator

permits direct measurements of noise factors as high as 20 db for r-f amplifiers and receivers operating from 10 to 1000 mc/s.

Type 584 UHF Frequency Meter

is a high Q Frequency Meter covering the band of 470 to 890 mc/s.

WESTERN SALES OFFICE: 737 NO. SEWARD STREET, HOLLYWOOD 38, CALIFORNIA



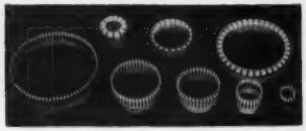
■ ENGINEER'S MICROWAVE KIT . . . saves time and money in development work. Contains 9 beryllium copper, jig-hardened circular contact rings and 6 finger contact strips.

*Micro-Processed**

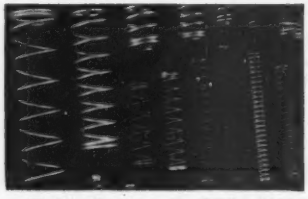
Beryllium Copper Springs

to help solve your radio-electronic problems

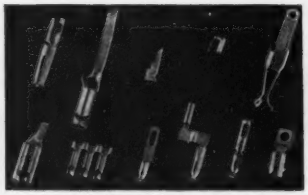
■ FINGER CONTACT STRIPS . . . for electronic equipment—available in a variety of contours without tool cost. Length—width—mounting holes—and finish optional. For information— *Write for Bulletin B-52.*



■ CONTACT RINGS . . . standard—and made to order. Truly circular—to insure equal pressure from all fingers. For information—*write for Bulletins C-52 and D-52.*



■ COIL SPRINGS . . . the finest available combination of high strength and uniformity. Made to your specifications.



■ MINIATURE SOCKET AND PLUG BOARD CONTACTS . . . produced with automatic tooling. Pressure on plug pins and tab ductility controlled within close limits.

■ ENGINEER'S ASSORTMENT . . . 100 beryllium copper helical compression springs . . . 50 pairs—all different.

Instrument Specialties Company, Inc.

■ 258 BERGEN BOULEVARD, LITTLE FALLS, NEW JERSEY

Telephone Little Falls 4-0280

**For full information on I-S Micro-Processed Springs—write for your copy of Catalog No. 7—"Micro-Processed Springs of Beryllium Copper".*

distributors for 30 years of radio and electronic components for all your needs

ADIO

IRE

ELEVISION

INCORPORATED

NEW YORK 13, N.Y.
100 Sixth Avenue
WAlker 5-8883

NEWARK 2, N. J.
24 Central Avenue
MArket 2-1661

BOSTON 10, MASS.
110 Federal Street
HUbbard 2-7850

Lafayette 100 SIXTH AVE.
DIV. RADIO WIRE TELEVISION, INC.
FOR CUSTOM RADIO AND TV COMPONENTS

Custom assemble your own high fidelity phono-radio-television ensemble. All famous name components at lowest prices. Send for Free hi-fi catalog to Dept. E.

SUB-MINIATURE and MINIATURE TUBES

R-f BEAM PENTODE TYPE 5851

MINIATURE PENTODE TYPE 6AU6

A full line of T-5½ and T-6½ miniature receiving and special-purpose tubes for radio, TV, radar and other electronic uses to be ready soon. Now available, T-3 sub-miniature types especially designed for military applications.

CATHODE RAY TUBES

TV PICTURE TUBE TYPE 21FP4A

Cathode ray tubes for military and other electronic applications in sizes from 3 to 27 inches. Rectangular and round Videotron television picture tubes up to 27 inches. Electrostatically and electromagnetically deflected types.

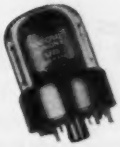
OCTAL TYPE RECEIVING AND SPECIAL PURPOSE TUBES

BEAM PENTODE TYPE 6V6GT

HIGH-VOLTAGE TRIODE TYPE 2C53

An extensive line of G and GT series receiving tubes for radio, radar and television equipments, plus special-purpose electron tubes for non-communications use and low power transmitters.

TRANSISTOR AND ELECTRON TUBE RESEARCH



30-ANODE RADIAL BEAM TUBE TYPE 5730

A separate and complete division for electron tube research and development. Transistor research now under way is leading to a new highly efficient design for this important new device. Now supplying subminiatures, radar indicators, radial beam tubes, secondary emission amplifiers and other types in pre-production quantities.

N.U. TUBES

for MILITARY and CIVILIAN USE

Reliable-Uniform Performance Through Continuing Research

RUGGEDIZED TUBES

Tube types with ruggedized construction for military applications and other special uses now available, having characteristics equivalent to the regular types. This series, which now includes 5R4WGY, 6SA7WGT, 6SL7WGT and 6SN7WGT, is constantly growing as developments in process are completed.

Send for complete list of tubes manufactured, including approved JAN types

NATIONAL UNION RADIO CORP.

MAIN OFFICE 350 SCOTLAND RD., ORANGE, N. J.

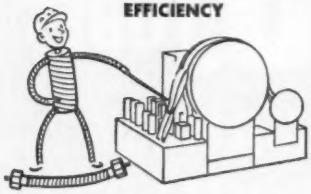
RESEARCH DIVISION ORANGE, N. J. • PLANTS NEWARK, N. J.—HATBORO, PA.

BIG ENOUGH TO SERVE YOU— SMALL ENOUGH TO KNOW YOU

A TIP FROM CHIEF ENGINEER FLEXY:—

Most electronic equipment contains parts and circuit elements which require adjustment or control from remote points. Whether the distance involved is a few inches or 50 feet or more, S.S.White flexible shafts should be considered as a means of providing the desired control. Here are four reasons why—

IMPROVED CIRCUIT EFFICIENCY



S.S.White flexible shafts give you all the freedom you need in locating controlled elements wherever desired to satisfy space, wiring, servicing and circuit requirements. They'll bring control to any point you need it.

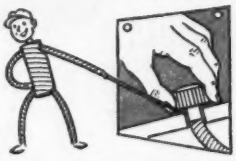
BETTER CONTROL PANEL ARRANGEMENTS

S.S.White flexible shafts simplify the job of getting a desirable grouping of the control knobs on the cabinet or instrument panel. They'll allow you to place the control knobs anywhere regardless of how the circuit elements are arranged.

FASTER ASSEMBLY

S.S.White flexible shafts are supplied in any desired length ready for installation. A simple coupling to the control knob and another to the variable element is all you need. No alignment, extra parts, or special assembly skill is required.

LIFELONG SENSITIVITY



S.S.White remote control flexible shafts are especially designed for this service. Tuning with them can be as smooth as a direct connection. What's more, they won't slip, wear out or lose their sensitivity. They're good for the life of the equipment.

Send For the 256-Page Flexible Shaft Handbook

It has full authoritative information and data on flexible shaft construction, selection and application. Copy sent free if you request it on your business letterhead and mention your position.

THE S.S.White INDUSTRIAL DIVISION
DENTAL MFG. CO.
Dept. E, 10 East 40th St.
NEW YORK 16, N. Y.

Western District Office • Times Building, Long Beach, California

when alcohol is inadequate. The opening is cut large enough for the window of a 21-inch rectangular tube, and the glass is set at an angle against taped-on guide strips when cleaning smaller pieces of glass. This method is used at Emerson's Jersey City plant.

Wire-Stripper Keeps Busy

WHEN all the wire-stripping machines in his department were loaded and running smoothly, operator E. J. Pike found he had nothing to do. From him came the suggestion for installing a solder pot

Solder pot near wire-stripping machine permits tinning wires during otherwise idle operator time

at one of the machines, so he could twist wire ends together and give them a solder dip while keeping one eye on the machines. This idea was given a Suggestion Award at RCA Victor's Camden, N. J. plant.

Production Testing of Selenium Cells

BY C. A. KOTTERMAN
Chief Engineer, Belcon Rectifier Division Bogue Electric Mfg. Co., Paterson, N. J.

and D. H. RANSOM
Director of Research & Development, Bogue Electric Mfg. Co., Paterson, N. J.

BOTH the forward and reverse characteristics of a single selenium rectifying cell can be measured simultaneously in 15 seconds with the simple yet accurate test circuit shown. This test can be applied to any quantity of cells during a daily production run, for sorting accord-

(*Advertisement*)

NEW DEVELOPMENTS

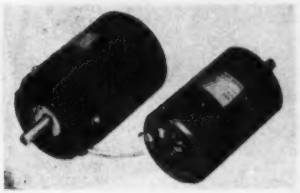
COMPONENTS ANNOUNCED

by the manufacturers represented

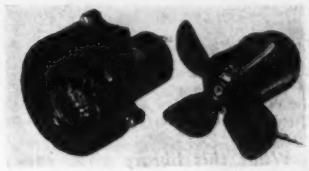
by HAROLD R. ELLIS

Special Induction Motors

INDUCTION MOTORS CORP.'s new miniature AC motors have unusually low temperature rises and are designed for operation from −65°C to as high as +85°C with standard A-type insulation. Special insulations are available for much higher ambient temperatures. Meeting all military specs, the series includes induction, synchronous, non-synchronous, 60-cycle, 400-cycle, variable-frequency, single-phase and polyphase motors in ratings of 1/1000 HP to 1/10 HP. These anodized aluminum sealed motors feature ruggedized construction, ball or sleeve bearings, midget size and weight for given HP rating, and protection from fungus and humidity extremes. Applied to all types of radar, timing, fire control, camera, servo and automatic devices, they are also used on IMC's own blowers and fans for cooling electronic tubes and assemblies. The centrifugal blowers range from tiny 1½" wheels through plastic 2", 2½" and 3" units on up to large metal-housed types providing high CFM and/or high pressure. Axial fans are available in similar variety. Induction Motors Corp., 55-15 37th Avenue, Woodside, N. Y.



Shockproof aluminum housings show perfect bearing alignment after shocks.



Lowered power input and heat rise give higher speed and air output, reduce size.

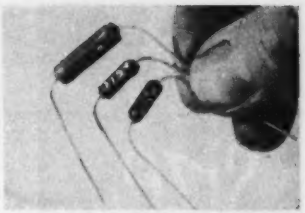
Industrial Solder Pack

H. J. ENTHOVEN & SONS LTD. eliminate waste and labor in the issuing of roughly-measured hanks of solder to production and maintenance personnel. Their accurately precut lengths, spooled within a cylindrical shockproof handle labeled with alloy, core and gauge, are compactly stored and inventoried, carried in tool kits without the solder becoming dirty, knotted or entangled with tools, and eliminate innumerable waste ends. H. J. Enthoven & Sons Ltd., c/o British Electronic Group, 366 Madison Avenue, New York 17, N. Y.

Colored Core Solder

H. J. ENTHOVEN & SON's colored core solders expose the "sloppy" wireman from among many doing the same operation. The colored core "Flashes" are basically the Enthoven water-white activated rosin core Superspeed solders with the addition of a minute amount of stable dye having no effect upon the wetting action for which the core is known. No extra charge is made for colored cores. As in Superspeed, the multiple fluted core's extraordinarily large area in contact with the solder metal insures its rapid collapse, permitting lower soldering temperatures for critical components or springs. All alloys, gauges and spool sizes of this non-corrosive, non-hygroscopic and non-odorous solder meet both military and Federal specs (QQ-S-571b). H. J. Enthoven & Sons Ltd., c/o British Electronic Group, 366 Madison Avenue, New York 17, N. Y.

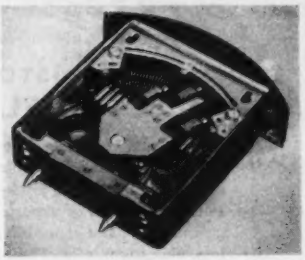
Superspeed's fluted core has greater area of dispersion than all competitive brands.



5½-watt P5101, right, is no larger than grain of pulled rice. Type MV1, center, is 4-watt economy size. Type P5306, left, is rated at 8½ watts to 15,000 ohms.

Midget Power Resistors

PAINTON & COMPANY's Type P5101 wound resistor, rated at 5½ watts, is now available for unrestricted applications. Values range from 1 to 4700 ohms in tolerance to 5% + .01%/°C. Also announced are Painton's Types MV1, P5306 and high stability deposited carbon resistors of ⅛ to 2 watts, in tolerances of 1%, 2% and 5%. All types are available in quick delivery. Painton & Company Ltd., 366 Madison Avenue, New York 17, N. Y.



Miniature broadcast remote controls have 21 and 30 steps, wide attenuation ranges.

Miniature Edgewise Fader

PAINTON & COMPANY have compressed their British Broadcasting edgewise fader into a new Type EM for limited panel spaces. A plug-in feature permits maintenance without interrupting facilities. The snap-open dust cover completely exposes the contact studs. Change over contacts operate at any predetermined position. Auxiliary contacts operate at both ends of the wiper travel. Single and double assemblies are suitable for bridge T networks. Painton & Company Ltd., 366 Madison Avenue, New York 17, N. Y.

SEE THEM AT BOOTH 244

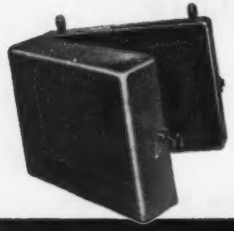
I.R.E. SHOW — MARCH 3-6

HAROLD R. ELLIS, Sales Rep.
366 Madison Ave., N. Y. 17, N. Y.
VAnderbilt 6-3417

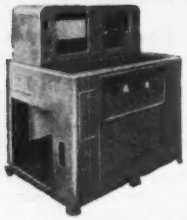
Area Representatives Wanted

any size...

CUBICLES • HOUSINGS • CABINETS



any quantity



CONTROL PANELS & DESKS

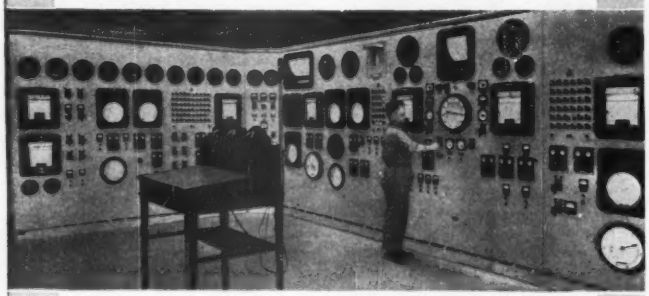
KIRK AND BLUM

CUSTOM BUILT

ELECTRICAL ENCLOSURES

One unit . . . hundreds . . . or thousands, in any shape or size. KIRK & BLUM has the men, equipment and experience to fabricate sheet metal enclosures to exacting specifications. Put our 45 years of experience to work for you in building custom parts and assemblies of sheet steel, light plate, stainless, aluminum, monel and other alloys in gauges to ⅜".

Write today for your copy of the latest KIRK & BLUM Electrical Enclosures Catalog. For prompt quotation, send your prints to The KIRK & BLUM MFG. CO., 3211 Forrer Street, Cincinnati 9, Ohio.



Control Desks • Cubicles • Electrical Cabinets and Enclosures
Outdoor Electrical Enclosures • Instrument Panels • Control Panels
Transformer Tanks • Test Stands • Switch Gear Housings • Louvres

KIRK AND BLUM

METAL FABRICATION

NOW

a really high-powered

RADIO ENGINEERING LIBRARY

Special Offer on This Complete Up-to-Date Set

Save $4.00! These fine engineering books would cost a total of $40.50 at our regular single-copy prices, if you bought them one or two at a time. Under this offer you can have the whole set at once and we'll pass along the saving in handling in a special low Library of only $36.50. In addition you may spread this over several installment payments as shown in the coupon below. Take advantage of these convenient terms to add these helpful books to your working library right away.

5 volumes, 3,921 pages, 2,770 illustrations

Eastman's FUNDAMENTALS OF VACUUM TUBES, *3rd Ed.*
Terman's RADIO ENGINEERING, *3rd Ed.*
Everitt's COMMUNICATION ENGINEERING, *2nd Ed.*
Hund's HIGH-FREQUENCY MEASUREMENTS, *2nd Ed.*
Henney's RADIO ENGINEERING HANDBOOK, *4th Ed.*

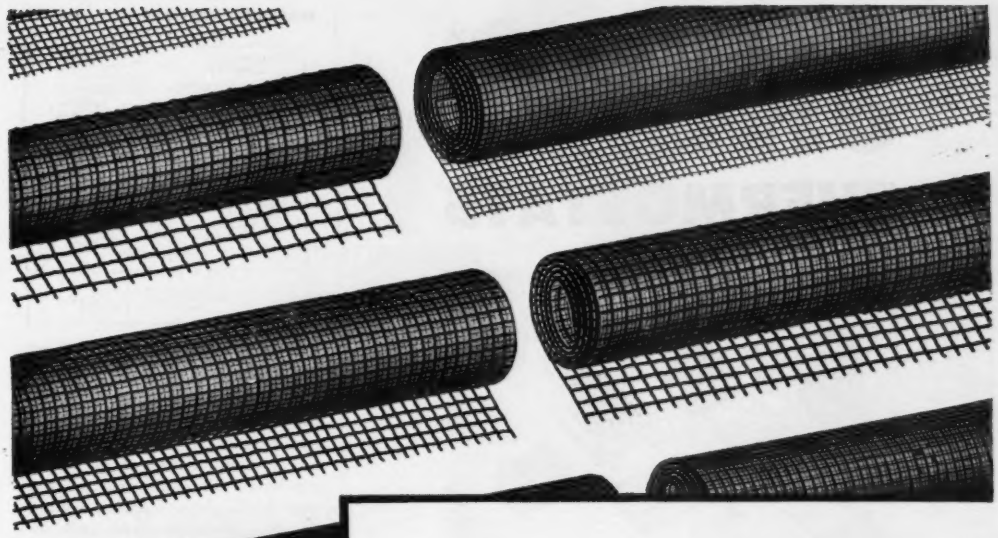
What this library gives you

These books cover circuit phenomena, tube theory, networks, measurements, and other subjects—give specialized treatments of all fields of practical design and application. They are books of recognized position in the literature—books you will refer to and be referred to often. If you are a practical designer, researcher, or engineer in any field based on radio, you need these books for the help they give in hundreds of problems throughout the whole field of radio engineering.

10 DAYS' FREE EXAMINATION

McGraw-Hill Book Co., 330 W. 42nd St., N.Y.C. 18
Send me RADIO ENGINEERING LIBRARY for 10 days' examination on approval. In 10 days I will send $6.50, plus few cents for delivery, and $6.00 monthly until $36.50 is paid, or return books postpaid. (We pay delivery if first payment accompanies this coupon; same return privilege.)

(Print)
Name .....
Address .....
City ..... *Zone* ..... *State* .....
Company .....
Position *EL-3-52*
(This offer applies to U.S. only)



BRASS AND COPPER WIRE CLOTH

When you need Industrial Wire Cloth or Strainer Cloth, your nearest Chase Warehouse is the place to inquire for it.

Chase Brass and Copper Wire Cloth is made in meshes from No. 2 to No. 100 and in varying gauges for a wide variety of industrial uses. The mesh is uniform and the wires double crimped to keep openings square and true.

One of the 23 Chase Warehouses or the four Chase Sales Offices will give you full information on the type of wire cloth best suited for your production problem. Send the coupon below for free Chase book describing the full line of Chase Brass and Copper Wire Cloth:

Chase BRASS & COPPER

WATERBURY 20, CONNECTICUT • SUBSIDIARY OF KENNECOTT COPPER CORPORATION

• *The Nation's Headquarters for Brass & Copper*

Albany†	Chicago	Denver†	Kansas City, Mo.	Newark	Pittsburgh	San Francisco
Atlanta	Cincinnati	Detroit	Los Angeles	New Orleans	Providence	Seattle
Baltimore	Cleveland	Houston†	Milwaukee	New York	Rochester†	Waterbury
Boston	Dallas	Indianapolis	Minneapolis	Philadelphia	St. Louis	(†sales office only)

FREE Chase Book lists mesh, diameter of wire, per cent of open area, weight and other important data.

Chase Brass & Copper Co., Dept. EL352
Waterbury 20, Conn.
Please send me your FREE book on Chase Brass & Copper Wire Cloth.

Name_____

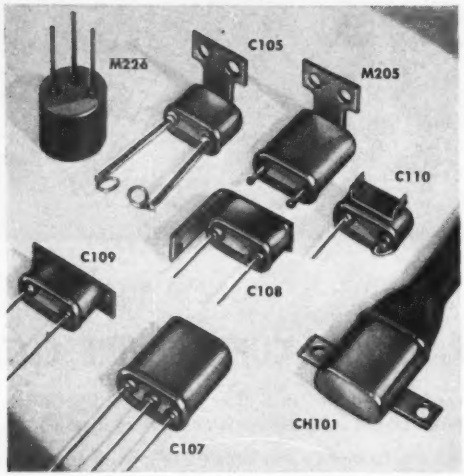
Position_____

Firm_____

Address_____

City_____ State_____

STEVENS* hermetically sealed THERMOSTATS



Bright plated or dull black finish. Terminals to customer specification. Thermostats shown approximately ¾ size.

Stevens Hermetically Sealed Thermostats—specially engineered for precision control of devices or equipment subjected to dust, moisture or corrosive atmospheres—are tightly, permanently sealed in corrosion-resistant metal cans. Some models have neoprene covered terminals. Virtually any type mounting bracket available.

Stevens Hermetically Sealed Thermostats are available in two basic styles: Type M bimetal disc for high-current circuits; Type C bimetal strip for low-current circuits, or for use in conjunction with disc types. *Both models feature a bimetal thermal element that eliminates artificial cycling or life-shortening "jitters."*

If your problem involves fast, accurate control of temperature under rugged atmospheric conditions, specify Stevens Hermetically Sealed Thermostats—they add to the life and sales of your product.

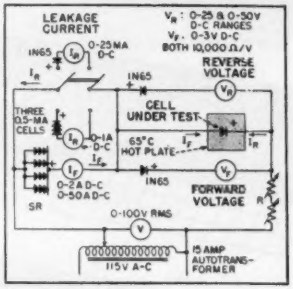
***Stevens also makes a complete line of standard bimetal disc and strip thermostats. Write for data.** A-6550

Type M thermostat patented; Type C, patent applied for

STEVENS

manufacturing company, inc.

MANSFIELD, OHIO



Test circuit, proposed as standard for metallic rectifier industry

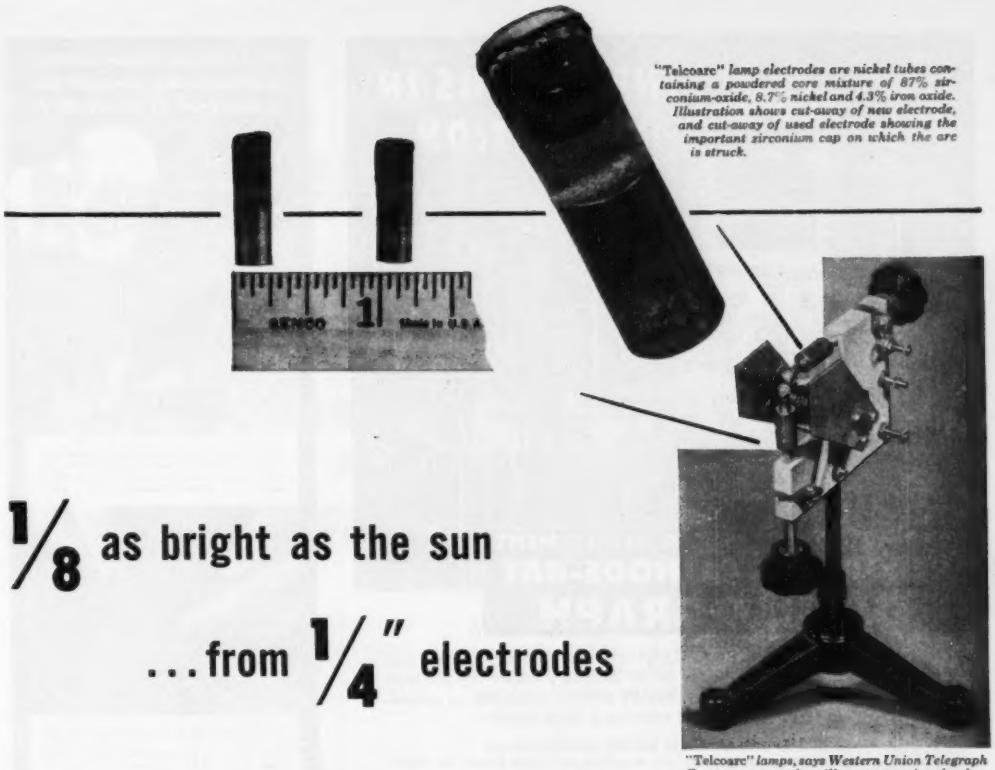
ing to characteristics as well as for quality control.

The circuit tests a single cell for maximum allowable leakage current for a given blocking voltage, and also checks the maximum allowable voltage drop for the current density the cell is processed to deliver. These two measured values form the basis for an acceptance or rejection test.

Selenium rectifier *SR* should have a leakage current of less than 0.0005 ampere per sq in. of actual rectifying area when blocking 20 volts rms per cell. This rectifier should pass more than 20 amperes continuously in the conducting direction and pass 40 amperes or more for the short time intervals necessary to make a test. Twelve special 5.5-ampere half-wave cells, each 6" x 6" in size, met this requirement.

To simulate field operational conditions, the test cell should be placed on a hot-plate maintained at 65 C by a built-in thermostat. This enables all cells to be tested at their minimum forward resistance and eliminates variations in ambient temperatures. Series load resistor *R*, used to establish the correct forward current value for the test cell, should have sufficient resistance range and wattage rating to handle the maximum current that the largest test cell is capable of passing in the conducting direction.

To make a measurement, the cell is placed on the hot-plate with the counter-electrode alloy surface facing upward. Connection to the alloy surface is made with a half-pound brass block that also presses the cell into intimate physical con-



"Telcoarc" lamp electrodes are nickel tubes containing a powdered core mixture of 87% zirconium-oxide, 8.7% nickel and 4.3% iron oxide. Illustration shows cut-away of new electrode, and cut-away of used electrode showing the important zirconium cap on which the arc is struck.

1/8 as bright as the sun

...from 1/4" electrodes

"Telcoarc" lamps, says Western Union Telegraph Company research, will prompt major developments in the projection, television, photographic, lithographic and photo copying industries, as well as in the medical field. They operate on either AC or DC.

Another tough metal problem solved by the use of Nickel

Western Union's open-air "Telcoarc" lamps give a controlled, concentrated spotlight one-eighth as bright as the sun. Yet the light is produced by only quarter-inch diameter nickel tube zirconium electrodes.

More than the light, the most unique fact about these lamps is the exceptional long life of the electrodes. In *open-air* at 650 watts, they are consumed at the rate of one inch in 100 hours.

It was no easy task to develop these electrodes. First the engineers had to find a metal for the outer tube to hold the zirconium-oxide filler—*a metal that did not oxidize readily.*

They tested a wide variety of materials. Then they tried Nickel!

The first Nickel tube electrode showed promise; but the core gave trouble. A poor conductor when cold, it had to be heated through the nickel outer tube. Also, a fragile oxide bead formed on the end of the electrode. These two defects indicated the need for a material to be added to the zirconium-oxide, in order to make it conductive when cold, and also to bond the bead and filler to the nickel tube.

More tests were made. Finally, zirconium metal powder was mixed with powdered nickel and pressed into the tube. When tested, the electrode performed satisfactorily and did not progressively oxidize, even with temperatures as high as 6500°F.

* *

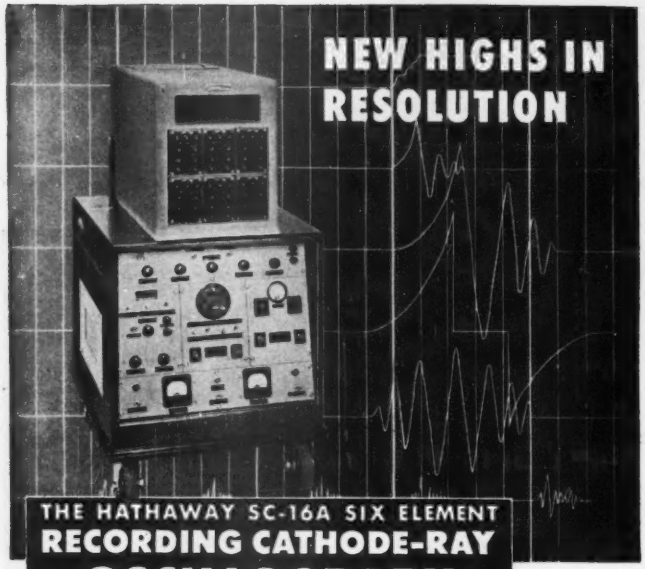
Good conductivity and resistance to high temperatures make nickel a valuable and economical metal for use in electronics. For example . . . to weld tungsten filament leads . . . and leads on miniature components.

If you have a special design problem, it will pay you to consider Inco Nickel Alloys. But remember, right now they are on extended delivery because so much is taken for defense. Therefore, ordering well in advance of your production schedule will improve your chances of getting delivery when you need it. For help with your problem write to Inco's Technical Service Dept., they will be glad to assist you. Also ask for your free copy of "66 Practical Ideas for Metal Problems in Electrical Products."

MONEL® • "R"® MONEL • "K"® MONEL "KR"® MONEL • "S"® MONEL • NICKEL • LOW CARBON NICKEL • DURANICKEL® • INCONEL® INCONEL "X"® • INCOLOY® • NIMONICS

Don't forget Booth #35. That's where we'll be during the I.R.E. Show at the Grand Central Palace, New York City, between March 3rd and 6th. Drop around and see us.

The International Nickel Company, Inc.
67 Wall Street, New York 5, N. Y.



THE HATHAWAY SC-16A SIX ELEMENT
RECORDING CATHODE-RAY OSCILLOGRAPH

NEW HIGHS IN RESOLUTION are obtained by this new oscillograph because of its unusually HIGH FREQUENCY RESPONSE and HIGH CHART SPEED...designed for recording fast transients and continuous phenomena.

FREQUENCY RESPONSE 0 to 200,000 cycles per second
RECORDS up to 1000 ft. long at speeds up to 600 inches per second
RECORDS up to 10 ft. long at speeds up to 6000 inches per second
WRITING SPEED as high as 5,000,000 inches per second

Note these additional unusual features.

- SIX ELEMENTS with convenient interchangeable lens stages for 1, 2, 3, or 6 traces on full width of chart.
- INTERCHANGEABLE RECORD MAGAZINES for CONTINUOUS RECORDING on strip chart, either 6 inches or 35mm in width up to 1000 feet in length, DRUM RECORDING for short, high-speed records, and STATIONARY CHART for very short transients.
- PRECISION TIMING EQUIPMENT, tuning fork controlled, for 1-millisecond or 10-millisecond time lines.
- Crystal-controlled Z-AXIS MODULATION for 1/10 millisecond time marks.
- QUICK-CHANGE TRANSMISSION for instantaneous selection of 16 record speeds over a range of 120 to 1.
- AUTOMATIC INTENSITY CONTROL.
- CONTINUOUS SWEEP OSCILLATOR which permits viewing as well as recording.
- Single-pulse LINEAR OSCILLATOR for recording transients on stationary film. The record can initiate the transient to be recorded, or the transient can initiate the record.

Each recording element is a complete unit, fully housed, which can be instantly inserted or removed. Recording element contains high-intensity cathode-ray tube, and both AC and DC amplifiers. Control panel is located on outside end.

FOR FURTHER INFORMATION, WRITE FOR BULLETIN 2 G1-G

Hathaway
INSTRUMENT COMPANY
1315 SO. CLARKSON STREET • DENVER 10, COLORADO

The Nonmelting Silicone Insulating and Waterproofing Compound that is stable from —70° to over 400° F.

Meets all Requirements of AN-C-128a

DOW CORNING 4 COMPOUND

Dow Corning 4 applied by brushing to AN connector receptacle of pilot's "jack box" prevents interference caused by moisture at this critical junction in aircraft communications system.

Dow Corning 4 applied by brushing to AN connector on V. H. F. Transmitter/Receiver excludes moisture without appreciable change in resistance across properly mated pin and socket connections.

Arrows show where Dow Corning 4 is used on variable inductance rollers in a Collins-Western Electric V. H. F. Transmitter/Receiver to lubricate, minimize resistance and reduce leakage losses.

Photos courtesy Braniff International Airways.

More water repellent than paraffin, Dow Corning 4 Silicone Compound is highly resistant to oxygen, ozone and deterioration caused by corona discharge.

Write Today! for your copy of our new booklet on Dow Corning 4 Compound. Address Department BD.

FIRST IN SILICONES
DOW CORNING CORPORATION
MIDLAND, MICHIGAN

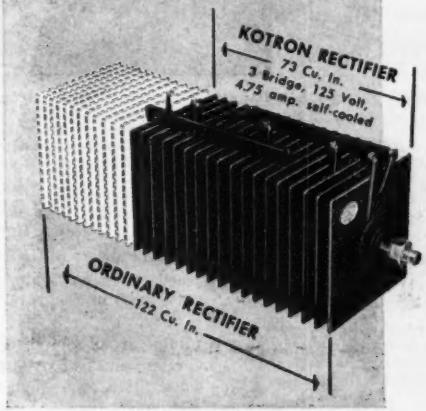
Rectifier efficiency!

YOU CAN COUNT ON KOTRON DAY AFTER DAY

- ⅓ SMALLER
- ⅓ LESS COST
- MORE EFFICIENT

PROVEN By Life Test PROVEN By Field Test

HIGH-VOLTAGE LOW-CURRENT SELENIUM RECTIFIERS



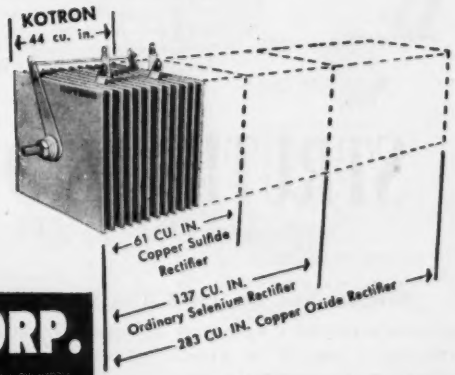
MORE ECONOMICAL RECTIFIERS BY KOTRON high voltage cells capable of withstanding 40 Volts AC rms. KOTRON cells processed to lower voltages increase the current carrying capacity of each square inch, reducing size and cost.

STURDY CONSTRUCTION IS BUILT IN . . . THEY SAVE SPACE . . . RETENTION OF ORIENTATION IS INSURED BY INTERLOCKING CELL AND TERMINAL CONSTRUCTION WHERE DOUBLE OR ECHELON TERMINALS ARE REQUIRED.

Every KOTRON Rectifier, for one ampere or thousands of amperes, is custom-built . . . tailored and designed for maximum efficiency with minimum size. KOTRON Rectifiers are built by specialists, backed up by years of technical experience. A consulting service, integrated with this specialized engineering knowledge, is available without obligation.

LOW-VOLTAGE HIGH-CURRENT SELENIUM RECTIFIERS

1 ohm, 9 Volt, 100 amp., center-tap, fan cooled fast charging KOTRON RECTIFIER. (Dimensions 3⅜" x 3¼" x 3⅜")



KOTRON RECTIFIER CORP.
54 CLARK STREET NEWARK 4, N. J.

Over 5,348 relay types . . . each subject to many electrical and mechanical adaptations . . . produced by a highly skilled organization which, for over 25 years, has specialized in relays exclusively.

Here is relay experience!

"RELAY ENGINEERING" the famous 640-page handbook brings you full benefit of Struthers-Dunn's experience in producing thousands of relay types for hundreds of applications. A complete, fully-illustrated guide to all phases of relay selection, use, circuitry and maintenance. Price $3.00.

STRUTHERS-DUNN

5,348 RELAY TYPES

Struthers-Dunn, Inc., 150 N. 13th St., Philadelphia 7, Pa.

BALTIMORE • BOSTON • BUFFALO • CHARLOTTE • CHICAGO • CINCINNATI
CLEVELAND • DALLAS • DETROIT • KANSAS CITY • LOS ANGELES
MINNEAPOLIS • MONTREAL • NEW ORLEANS • NEW YORK • PITTSBURGH
ST. LOUIS • SAN FRANCISCO • SEATTLE • SYRACUSE • TORONTO

tact with the surface of the hot-plate. The autotransformer and R are then adjusted until the ammeter I_F shows that the cell is passing its rated half-wave current in the conducting direction. The forward voltage drop across the cell is then read on V_F. The product of the readings of I_F and V_F is the forward power dissipation of the rectifier under test. A wattmeter could be used here if desired.

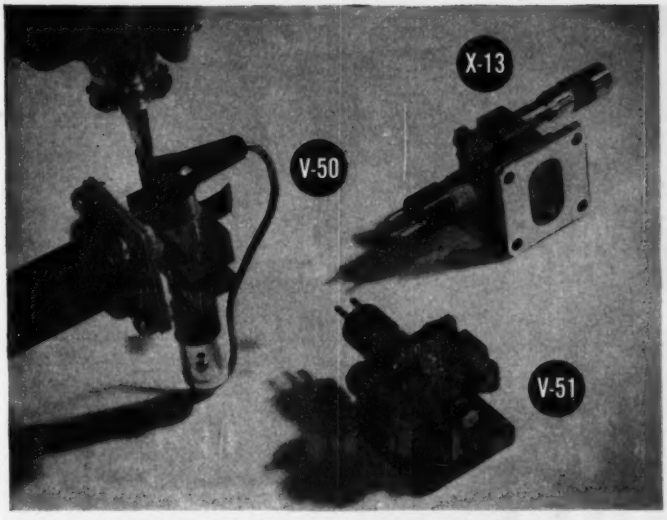
During the reverse cycle, current I_R flows through R (which has a negligible voltage drop), through the rectifier under test and through the appropriate range of reverse-current ammeter I_R. The blocking voltage is read on voltmeter V_R,

Test setup for measuring forward and reverse resistance characteristics of single selenium cells. Hot-plate on bench holds four cells, reducing waiting time for warm-up

and is equal to one-half the rated blocking voltage of the cell. The product of the readings of I_R and V_R is the power dissipated in the rectifier under test in the reverse direction.

The readings of all the meters are the average values of one-half of a sine wave. It is convenient to have voltmeters V_F and V_R calibrated in terms of the equivalent full-wave bridge rectifier values in addition to the regular calibration, by having a second scale with double values or calibrated in terms of peak readings which are 3.14 times the average half-wave values.

While waiting for the cell to reach the hot-plate temperature, the autotransformer and R can be adjusted. The autotransformer output voltage should be reduced to zero before removing the test cell, to avoid damage to meters, and



VARIAN associates

REFLEX KLYSTRONS for RUGGED SERVICE

8.5 to 10.0 kmc

Development based on the widely-used Varian X-13 klystron has produced two new Varian tubes with unusual possibilities for X-band applications involving extreme shock and vibration.

V-50 RUGGED, TUNABLE RADAR LOCAL OSCILLATOR. Here is a tube capable of withstanding severe vibration and shocks well beyond 30 times gravity It is tunable with extreme smoothness over the band from 8.5 to 10.0 kmc, and can be used with conventional afc circuits. Power output is 25 milliwatts, minimum, with a resonator voltage of 300 volts. The output connector mates with UG39/U flange (1 x ½" waveguide).

V-51 RUGGED RADAR L. O. OR LOW-POWER TRANSMITTER. Lock-nut tuning enables the Varian V-51 klystron to withstand even rougher treatment than the V-50. Frequency range, application, and construction are otherwise similar. Tuning is easily done in the field with a standard open-end wrench. This tube is capable of 75 milliwatts, minimum, at 350 volts on the resonator. The output connection also mates with a UG39/U flange.

X-13 GENERAL-PURPOSE X-BAND SIGNAL SOURCE. A versatile, stable, reliable, laboratory-type signal source, the familiar Varian X-13 klystron tunes readily with a built-in micrometer device over a wide frequency range of 8.2 to 12.4 kmc. The X-13 is not intended for rugged service. It delivers well over 100 milliwatts at a resonator voltage of 500 volts. Output connection is a UG39/U flange.

Send for your copies of data sheets giving full information about this group of X-band Varian klystrons. There is a Varian Associates field representative nearby to assist on any application problems you may have.

Meet MIL-T-5422 and AN-E-19 specifications

SEE THESE TUBES AT IRE NATIONAL CONVENTION NEW YORK, MARCH 3 TO 6
BOOTH 55

VARIAN associates
990 VARIAN STREET · SAN CARLOS, CALIFORNIA
Representatives in Principal Cities

MOSINEE

"More than Paper"

In the field of electronics and the electrical goods industry, MOSINEE stands for paper-base processing materials with scientifically controlled chemical and physical properties, high quality standards and dependable uniformity . . . with good dielectric strength, high tensile or tear strength; proper softness or stiffness; creped with controlled stretch or flexibility; specified pH for maximum-minimum acidity or alkalinity; accurate caliper, density, liquid repellency or absorbency . . . or other technical characteristics vital to your quality standards and production requirements.

MOSINEE PAPER MILLS COMPANY • MOSINEE, WIS.

"Essential Paper Manufacturers"

ENGINEERS
DESIGNERS
PHYSICISTS

THE Aerophysics & Atomic Energy Research Division of North American Aviation, Inc., offers unparalleled opportunities in Research, Development, Design and Test work in the fields of Long Range Guided Missiles, Automatic Flight and Fire Control Equipment and Atomic Energy. Well-qualified engineers, designers and physicists urgently needed for all phases of work in

Supersonic Aerodynamics,
Preliminary Design & Analysis,
Electronics,
Electro-Mechanical Devices,
Instrumentation,
Flight Test,
Navigation Equipment,
Controls,
Servos,
Rocket Motors,
Propulsion Systems,
Thermodynamics,
Airframe Design,
Stress & Structures.

●

Salaries Commensurate with training & experience.
Excellent working conditions.
Finest facilities and equipment.
Outstanding opportunities for advancement.

Write now—Give complete resume of education, background and experience

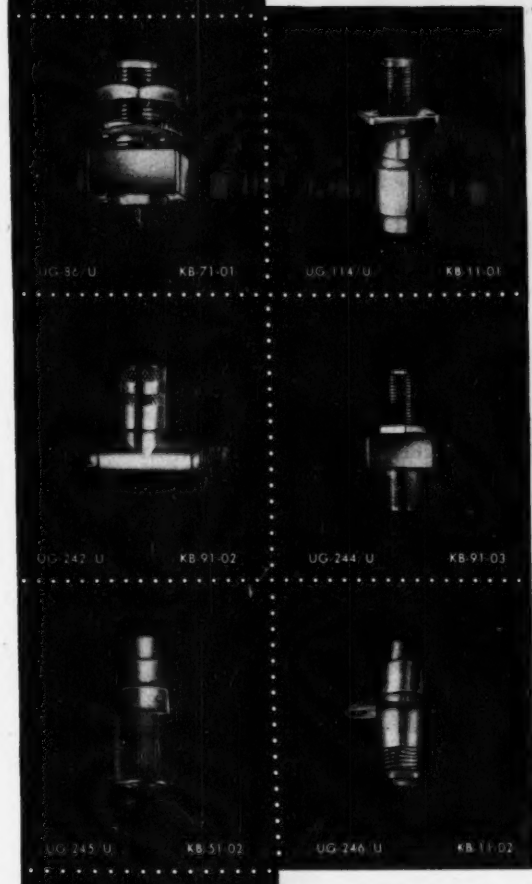
●

PERSONNEL DEPT.
AEROPHYSICS & ATOMIC ENERGY RESEARCH DIVISION

NORTH AMERICAN AVIATION
INC.
12214 LAKEWOOD BLVD.
DOWNEY, CALIFORNIA

BN

CONNECTORS BY KINGS



BN Connectors are small, lightweight connectors designed for use with small cables such as RG-55/U, RG-58/U and RG-62/U. They are widely used for Video, I. F., Trigger Pulse and Low-Power R. F. applications.

During its many years of collaboration with our Armed Forces, Kings has developed engineering skills and production know-how that have won them "top-priority" with radio and electronic engineers everywhere. Constant research and rigid quality control are responsible for the increasing demand for Connectors by Kings.

Our fully-staffed engineering department is ready to serve you promptly and skillfully. You'll be glad you called on Kings first.

KINGS *Electronics* CO., INC.

40 MARBLEDALE ROAD, TUCKAHOE, N. Y.

IN CANADA: ATLAS RADIO CORP., LTD., TORONTO

NEW-Fast-Reliable-Lower Cost!

* DIRECT READING
* COUNTING TO 1,000,000 CPS
* RUGGED PLUG-IN CONSTRUCTION

Berkeley's complete line of decimal counting units includes the improved Models 700A and 705A, now offering higher counting speeds, increased stability and longer operating life. Two new units, the 706A and 707A, have been added to provide maximum counting rates of 350,000 and 1,000,000 cps respectively. All units are designed for cascade arrangement to provide any desired total count capacity. All units of same model number interchangeable without adjustment. Instantaneous reset to zero through opening of grid return circuit.

SPECIFICATIONS

	MODEL 700A	MODEL 705A	MODEL 706A	MODEL 707A
Maximum Counting Rate	40,000 cps	100,000 cps	350,000 cps	1,000,000 cps
Resolution—Pulse Pairs	5 μ sec.	5 μ sec.	1 μ sec.	0.8 μ sec.
Tubes	4-5963	4-5963	4-5963 5-6AL5	4-5687 6-6AL5
Plug-In Mounting	Octal	Octal	11 pin	11 pin
Dimensions	1⅜"x5½"x5½"	1⅜"x5½"x5½"	2½"x5½"x5½"	3¼"x5½"x5½"
Weight	12 oz.	12 oz.	24 oz.	24 oz.
Price*	$50	$60	$95	$145

* **LOWER COST — *A Berkeley Policy***

Continually-widening applications for Berkeley instruments and components have enabled us to realize substantial economies in manufacturing cost. These benefits are distributed equably among those who have made them possible—our customers, our engineering and manufacturing group, and our field organization. To you, the user of Berkeley instruments, these benefits accrue in the form of better and better equipment at lower and lower cost.

FOR COMPLETE INFORMATION, please write for bulletin 700-E

Berkeley Scientific Corporation

2200 WRIGHT AVENUE • RICHMOND, CALIFORNIA

should be kept at zero until after the next cell is put on. Keep the brass weight on the hot-plate, so the weight stays hot and does not conduct heat away from the next test cell.

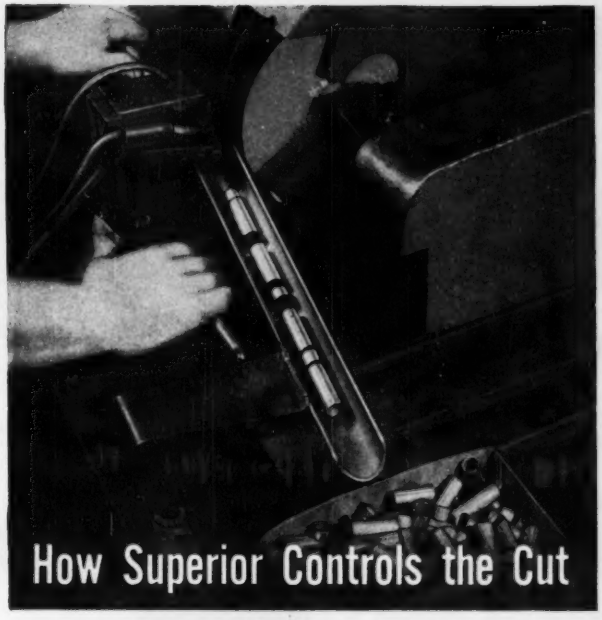
With slight modifications, the test circuit described can be adapted to the testing of copper-oxide rectifier cells, but has little practical value for testing copper-sulphide cells because of their high leakage currents.

It is hoped that through publication of this test circuit, manufacturers and users of selenium rectifiers as well as government testing laboratories and all agencies setting up standards or procurement specifications for metallic rectifiers will adopt this method. The metallic rectifier industry will then have, for the first time, a universally accepted and standard method for testing metallic rectifier cells.

Applying Paint With Oiler

USE of a fountain-pen-type oiler for applying colored lacquer or glyptol to each soldered joint during in-

Oiler filled with red lacquer is used in place of brush to mark soldered joints that pass inspection



How Superior Controls the Cut

to give you better tubular parts

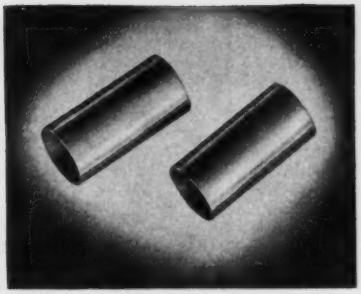
● Cutting tubing into exact lengths as the first step in the fabrication of tubular Electronic parts is a simple operation. Or is it?

Complications set in when the temper of the tubing is changed to meet customer specifications; when the tubing to be cut has a wall .010" or thinner; when length tolerances as close as .010" are required; when a 3° to 10° angle cut with a tolerance of ± ½° is called for; and when flattening, denting or other distortion must be prevented.

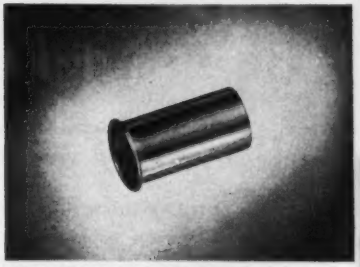
But overcoming complications in simple operations . . . and finding ways around them in other basically more difficult ones, is a specialty of the Electronics Division of Superior.

Our customers for Electronics parts have come to expect us to deliver the goods, exactly to specifications, whether standard production or complex experimental parts. What's more, they frequently ask us for suggestions about improvement on their designs and specifications . . . and they get them.

There is nothing unusual about all this—it's our job and we know how to do it. If you are a manufacturer or experimenter in the Electronics Industry and you need a tubular part that presents a problem, tell us about it. We'll probably be able to help and will gladly do so. Write The Superior Tube Company, 2500 Germantown Ave., Norristown, Pennsylvania.



Cutting and Tumbling. Cutting machines and jigs of many types and sizes are combined with extensive tumbling equipment to permit fast accurate production of quantities of parts at Superior.



Fabrication: Parts can be readily rolled at either or both ends, flared, flanged, expanded, or beaded (embossed) as required. The anode above is one of many such parts we produce at high speed and low cost.

The Finished Part. Final stage in the fabrication of the part shown above at three stages of production is a bend nicely controlled for both precise angle and freedom from other, unwanted distortion.

This Belongs in Your Reference File

. . . Send for It Today.

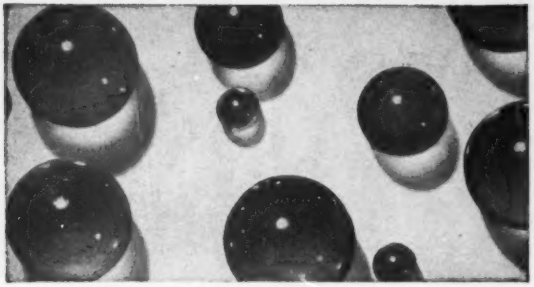
NICKEL ALLOYS FOR OXIDE-COATED CATHODES: This reprint describes the manufacturing of the cathode sleeve from the refining of the base metal. Includes the action of the small percentage impurities upon the vapor pressure, sublimation rate of the nickel base; also future trends of cathode materials are evaluated.

Superior

THE BIG NAME IN SMALL TUBING

All analyses .010" to ¼" O.D.
Certain analyses (.035" max. wall) Up to 1¼" O.D.

***SUPERIOR TUBE COMPANY** • Electronic products for export through Driver-Harris Company, Harrison, New Jersey • Harrison 6-4800*



Now PRECISION BALLS *of Synthetic Sapphire*

Now . . . the wear, corrosion, and heat resistance of synthetic sapphire in balls polished to within 20 micro-inches of sphericity.

THESE unicrystalline spheres resist corrosion or erosion by many acids and alkalis . . . possess a higher dielectric strength than glass or mica . . . have a low coefficient of friction and superior hardness. In many applications, they need not be lubricated.

LINDE synthetic sapphire balls are available in 1mm, 3/32 inch, 1/8 inch, and 1/4 inch sizes. Three surface finishes are available: super-finished, semi-finished, and rough-ground blanks.

CALL or WRITE any LINDE office for information on these balls, or the other forms of LINDE synthetic sapphire.

PROPERTIES

Composition	Al_2O_3
Coefficient of Friction (Steel pivot on sapphire ring)	0.140
Hardness (Knoop)	1525—2,000
Modulus of Elasticity in Flexure	50—56 x 10^6 psi
Dielectric Constant	7.5—10
Modulus of Rigidity	21.5—27.5 x 10^6 psi
Thermal Coefficient of Expansion up to 50°C (per °C x 10^{-6})	5.0—6.7
Chemical Resistance	Unaffected by acids, dilute alkali.

LINDE AIR PRODUCTS COMPANY

A DIVISION OF UNION CARBIDE AND CARBON CORPORATION

30 E. 42nd St., New York 17, N. Y. UCC Offices in Other Principal Cities

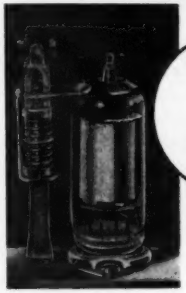
In Canada: DOMINION OXYGEN COMPANY, LIMITED, Toronto

The term "Linde" is a trade-mark of Union Carbide and Carbon Corporation.

BIRTCHER TUBE CLAMPS

Hold Tubes in Sockets Under all Vibration, Impact and Caustic Conditions

83 VARIATIONS FOR STANDARD TUBES



NEW CLAMP FOR MINIATURE TUBES

You can't shake, pull or rotate a tube out of place when it's secured by a Birtcher Tube Clamp. The tube is there to stay. Made of Stainless Steel, the Birtcher Tube Clamp is impervious to wear and weather.

BIRTCHER TUBE CLAMPS can be used in the most confined spaces of any compact electronic device. Added stray capacity is kept at a minimum. Weight of tube clamp is negligible.

Millions of Birtcher Tube Clamps are in use in all parts of the world. They're recommended for all types of tubes: glass or metal—chassis or sub-chassis mounted.

THERE'S A BIRTCHER TUBE CLAMP FOR EVERY STANDARD AND MINIATURE TUBE!

Write for samples, catalogue and price lists.

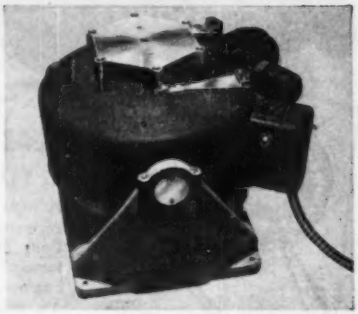
THE BIRTCHER CORPORATION
4371 Valley Blvd.
Los Angeles 32, Calif.

▶ SEE US AT BOOTH 273, I. R. E. SHOW ◀

CALIDYNE VIBRATION TEST EQUIPMENT

for testing to

Air Force, JAN, MIL, and other environmental test specifications



TRADE MARK

Model	Force rating	Maximum acceleration	Load for 20g (Pounds)	Load for 10g (Pounds)	Frequency range std. supply, cps	Signal generator
6	25	38.0	1/2	1-7/8	2 or 7 to 70,000	none
6C	25	34.5	1/2	1-7/8	2 or 7 to 70,000	velocity
6T	50	43.5	1-1/3	4-7/8	2 or 7 to 70,000	none
6CT	50	41.5	1-1/4	4-7/8	2 or 7 to 70,000	velocity
46	15	23.0	1/10	7/8	2 or 7 to 70,000	acceleration
49	25	34.5	1/2	1-7/8	2 or 7 to 70,000	velocity
44	450	54.5	14	36-3/4	2 to 500 or 2000	velocity (opt.)
48	2500	38.0	50	185	3 to 500	velocity

Contact our representatives or consult our engineers regarding special requirements for cycling, monitoring, or controlling these shakers. We specialize in equipment for vibration testing, and offer many standard and special instruments for measuring, calibrating, and standardizing.

PICKUPS

Special pickups in ranges from 1g to 100g, and natural frequencies up to 1700 cps. Water-tight and pressure-tight cases available.

Model	g-range	Minimum natural frequency	Sensitivity volts/g
18B-5	5	110	3.0
18B-10	10	150	1.5
18B-25	25	250	0.6
18B-50	50	380	0.3

COUPLERS

Couplers for using pickups with recording oscillographs or cathode-ray oscilloscopes are available for single- or multi-channel use.

STANDARDS

Model 3 and Model 23 Calivolters

—for voltage standardization of amplifiers and monitors. A precise working standard which can be readily checked against primary laboratory standards.

CALIBRATORS

Model 1 and Model 6C Calibrators

—for calibrating accelerometers and velocity pickups respectively, by use of a rapid and accurate ratio method. Bulletin on request.

METERS

Model 38 Vibrascope

Uses direct-coupled Model 18B pickup as input to combination vibration meter and calibrated oscilloscope for measuring acceleration, velocity, or displacement, and giving frequency and wave form indication.

Model 5 Vibration Meter

Direct-reading in acceleration, velocity, or displacement units when using velocity type pickups. A very compact, battery-operated unit.

Model 54 Signal Monitor

AC-operated unit for direct measurement of displacement or g output of shakers having velocity signal generators.

THE CALIDYNE COMPANY

SALES REPRESENTATIVES IN

NEW YORK, N. Y.
G. C. Engel ● Exeter 2-4081

WASHINGTON, D. C.
P. G. Hoffer ● Exeter 2081
Republic 1020

CHICAGO, ILLINOIS
H. W. Moreland & Associates 5-0822

PHILADELPHIA, PENNA.
D. J. Connor Co. ● Locust 4-3200

FLORIDA
A. H. Lynch and Associates
Fort Meyers 3-6702

DALLAS, TEXAS
J. A. Green Co. ● Blake 1702

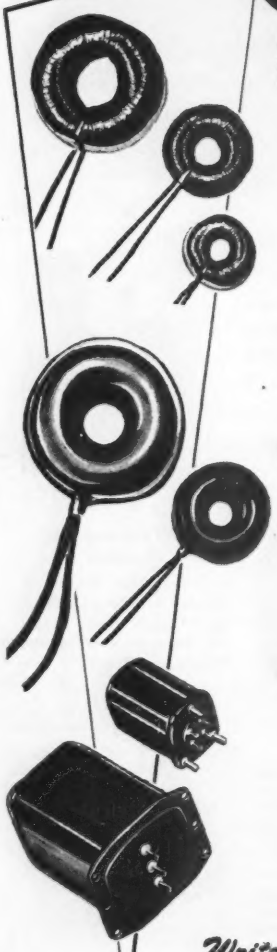
751 MAIN STREET WINCHESTER, MASSACHUSETTS

MINNEAPOLIS, MINN. HOLLYWOOD, CAL. CLEVELAND, OHIO PORTLAND, OREGON

at BOOTH 273

you'll find a complete display of Calidyne products, and engineers to answer your questions.

When You Think of
TOROIDAL COMPONENTS...
Think of
COMMUNICATION
ACCESSORIES CO.



UNCASED COILS ADJUSTED TO YOUR SPECIFICATIONS

A wide variety in physical size, power capacity and frequency range is offered. Coils are wound to comply with customers' requirements and specifications. Engineering assistance and suggestions are offered without charge.

Coils may be supplied to a tolerance of plus or minus one percent, or matched to a standard inductor to a tolerance of one-tenth percent, or one turn.

Coils may be supplied with temperature coefficient of 180 parts per million per degree Centigrade, or may be supplied with 0° C. coefficient through a limited temperature range.

MOISTURE PROOF PLASTIC COATED TOROIDS

To eliminate the possibility of damage to the exposed winding during assembly, we offer toroids coated with tough thermal setting plastic coating. These coated toroids are recommended where coils are subject to high humidity and where coils must be mechanically mounted. Plastic coating is available in all types of toroidal coils.

STEEL CASED TOROIDS AND FILTERS

C.A.C. engineers, with years of experience in the design of filter networks are at your service to design or help you design the proper networks for your requirements. Where space requirements are severe, filters may be miniaturized by the use of wedding ring toroids and special capacitors. Typical filter cases are shown. However, cases may be fabricated to your specifications.

Write for our latest catalog

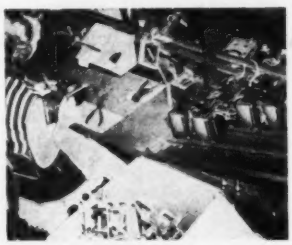
COMMUNICATION ACCESSORIES Company

HICKMAN MILLS, MISSOURI

spection proved faster and more satisfactory than the conventional paintbrush technique in the mobile radio transceiver manufacturing section of an RCA plant in Camden. Operator can work steadily, whereas former brush method required redipping of brush in lacquer at regular intervals.

Slide For Transformers

TO KEEP a supply of heavy TV-receiver power transformers within easy reach of an operator at all times, the units are loaded onto a metal-bottom slide in DuMont's East Paterson, N. J. plant. Partitioning strips divide the slide into four rows, separated sufficiently so transformers in adjacent rows cannot catch on each other. Stock boys replenish the supply at their leisure.



Transformers feed to operator by gravity each time she takes one from bottom of slide for subassembly operation involving mounting of rectifier socket and bracket

Sample-Testing CRT Cables

A SIMPLE test setup consisting essentially of two selector switches and an ohmmeter is used to check correctness of color-coded wiring to the socket of a television picture-tube cable, during sampling inspection of incoming cables at the Television Receiver Division of DuMont in East Paterson, N. J. Zero ohmmeter reading when both switches are set at the same number indicates continuity as well as correctness of wiring. The wire ends of the cables are pushed into clips on the panel. Colored-wire connections to these clips are run over the top of the panel for a short distance intentionally to serve as color iden-

Emerson says:

"Murray Breakers... safe, dependable protection for highly sensitive electronic equipment"

Murray Breakers always carry full load, regardless of temperature. They never need "derating."

Fully Magnetic!

PHONE CHELSEA 2-1000 CABLE ADDRESS EMPHONOCO NEW YORK CODES BENTLEYS ABC 6TH EDITION IM

Emerson
RADIO AND PHONOGRAPH CORPORATION
111 EIGHTH AVENUE NEW YORK CITY, 11

Murray Mamufacturing Corporation
1250 Atlantic Avenue
Brooklyn 16, New York

Dear Sir:

Every Emerson Television and Radio Set undergoes a series of rigid tests using delicate electronic instruments.

During these tests a momentary short circuit or overload could damage or destroy the electronic equipment. A safe dependable means of circuit protection must be used.

It has been our experience that the Murray fully magnetic circuit breaker provides this safe dependable protection for the highly sensitive electronic equipment used in these tests.

We had tried various other types of circuit protection before we began using the Murray fully magnetic circuit breaker and none operated as well.

We would not hesitate to recommend very highly the Murray product.

Yours truly,
EMERSON RADIO AND PHONO.

C. Gustafson

C. Gustafson
Plant Engineer

CG/lf

Here is a typical Murray Breaker set-up used by Emerson in testing television sets

For the complete story on Murray Circuit Breakers, write for Bulletin 530

IF YOU WANT TO INSTALL THE BEST... specify Murray®

MURRAY MANUFACTURING CORPORATION

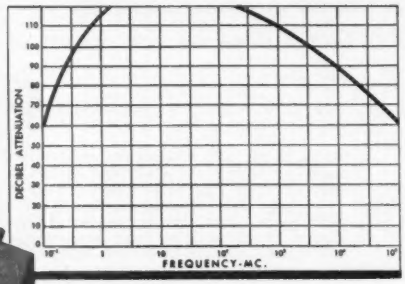
1250 Atlantic Avenue, Brooklyn 16, New York

Service Entrance & Meter Equipment • Magnetic Circuit Breakers • Switches • Current Limiting Reactors • Crows'nest Aerial Ladders

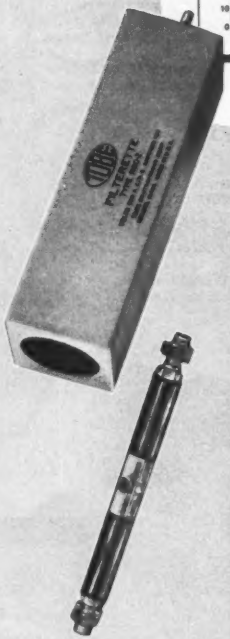
Now your Screen-rooms can be

RADIO-SILENT

from 0.150 to 25,000 mc.



TOBE



TOBE FILTERS

for screen-booth power lines cover the entire spectrum from the LF through the SHF range with high attenuation at all frequencies.

The performance curve above shows the combined attenuation of a double-shielded test room, a Tobe #1180-2 medium-range filter, and a Tobe #1457-1 high-range filter. The filters, rated at 100 amperes 500 volts a.c./d.c., have a total line drop of only 0.2 volts per circuit at full load; others available at lower and higher ratings.

Catalog E-201 giving electrical characteristics, dimensions, mounting provisions, weights, terminal data, and recommendations for your use of wide-range line filters is free on request. WRITE TODAY.

TOBE

TOBE DEUTSCHMANN

CORPORATION

NORWOOD, MASSACHUSETTS

"IT'S GOTTA BE RIGID and FLEXIBLE — TRANSPARENT and OPAQUE . . . I BETTER GO TO THE PLASTICS SHOW!"

Every facet of the vast plastics industry will be concentrated in Philadelphia's Convention Hall. You will see what's *new* in research, raw materials, machinery, and production techniques. If there's an answer to your problem in the plastics industry, you'll find it at the Exposition. *This exposition is not open to the public. Requests for admission tickets should be written on your company letterhead directed to* THE SOCIETY OF THE PLASTICS INDUSTRY, Inc., 67 W. 44th Street, New York 18, N.Y.

1952 NATIONAL PLASTICS EXPOSITION

PHILADELPHIA CONVENTION HALL

MARCH 11 - 14 , 1952

The biggest "small part" in the world!

Many of the parts needed in factory production are mighty small. But these parts can loom up mighty *large*—when they're missing!

For tiny as they are, their absence can halt an entire production line—can cost a manufacturer thousands of dollars *every day* while he waits for replacements to arrive.

And the sources of supply are often hundreds of miles from his factory!

What does he do? He cuts replacement time from days to hours. He gets needed parts the world's fastest way—via Air Express!

The money saved by Air Express speed is figured in millions—but its cost is counted in pennies. Whether you need steel bolts or bolts of cloth, you can profit from regular use of Air Express. Here's why:

IT'S FASTEST—Air Express gets *top priority* of all commercial shipping services—gives the fastest, most complete door-to-door pick-up and delivery service in all cities and principal towns at *no extra cost.*

IT'S DEPENDABLE—Air Express provides one-carrier responsibility all the way, gets a *receipt upon delivery.*

IT'S PROFITABLE—Air Express service costs less than you think, gives you many profit-making opportunities.

New parcel post regulation affect you? Call your local agent of Railway Express, Air Express Division.

AIR EXPRESS

GETS THERE FIRST

Test, Grade, or Match Resistors

"as fast as you can pick 'em up!"

PRICE $585.00 F.O.B. CINCINNATI

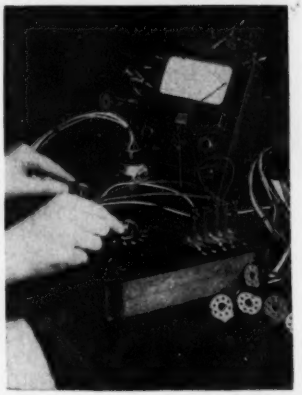
with the new *Clippard* PR-5 RESISTANCE COMPARATOR

Just place the "unknown" resistance across the terminals of this precision, production Clippard tester. Even unskilled operators can process up to 30 resistors (of all types) *per minute.* Working to an accuracy of better than ±1% through the entire range of 100 ohms to 100 megohms, the PR-5 is a companion instrument to the famous PC-4 Automatic Capacitance Comparator. With it, radio, electrical, resistor manufacturers and large part jobbers save time and money and assure unerring accuracy of inspection.

Completely self-contained, the PR-5 requires no outside attachments other than the Standard Resistor against which unknowns are checked. Operates on 110 Volt—60 Cycle AC. Range: 100 ohms to 100 megohms; reads deviation from standard on any of three scales: −5% to +5%, −25% to +30% or −50% to +100%. Size: 18" x 12" x 12". Weight: approx. 32 lbs. For complete details, write for Catalog Sheet 3-E.

Clippard
INSTRUMENT LABORATORY INC.
1125 Bank Street • Cincinnati 14, Ohio

MANUFACTURERS OF R. F. COILS AND ELECTRONIC EQUIPMENT



Incoming-inspection setup for picture-tube cables. Carrying-strap buttons of multimeter fit into slots in simple metal stand for holding meter at optimum angle

tification for the clips, so the operator merely matches colors when inserting wires in clips. A mounted octal tube base makes all connections automatically to the socket under test.

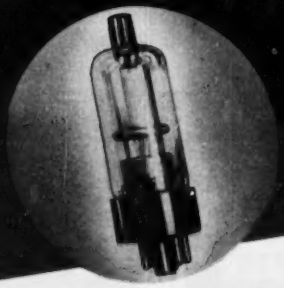
Self-Counting Parts Trays

SHALLOW wood trays in standardized sizes up to about 2 feet square are used in the Hawthorne, N. J. plant of Servo-Tek Corp. for transporting and storing component parts of servo amplifiers, small synchros and motors. The trays stack solidly one on top of the other. The number of parts in each tray can be counted almost at a glance by multiplying the number of parts per row in the tray by the number of rows of parts in the tray. Empty trays are furnished to subcontractors, saving packing and rehandling costs on incoming materials.

Plastic Clothespins Serve as Defect Indicators

WHEN an operator on Emerson's moving-belt television assembly line cannot finish her work within the allotted time cycle, perhaps because of a broken terminal or trouble with a joint, she is instructed to clip a colored plastic clothespin to

Good names to know for –



FILAMENT BASE METALS:

SYLVALOY
MODIFIED HILO
COBANIC
TENSITE
UNIMET

CARBONIZED NICKEL:

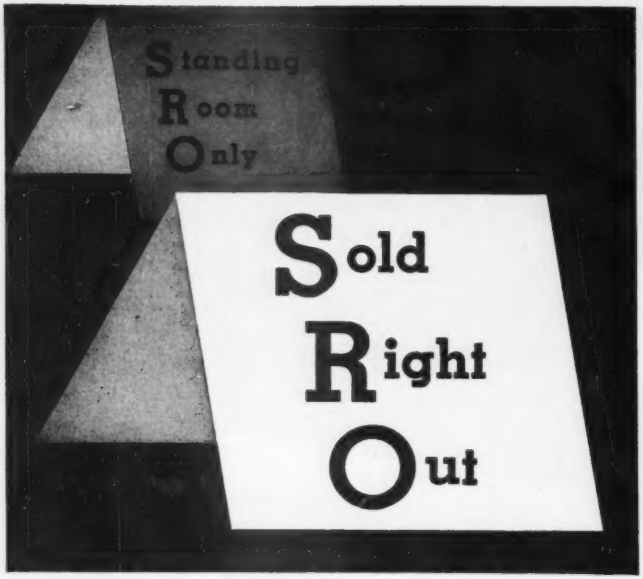
RADIOCARB
DUOCARB
POLICARB

GRID WIRE:

MANGRID

WILBUR B. DRIVER

WILBUR B. DRIVER COMPANY
150 RIVERSIDE AVENUE, NEWARK 4, NEW JERSEY



We're sorry, but we think it's only fair to tell possible new customers our Standing Room Only sign must be changed to Sold Right Out!

The design and production facilities of our microwave department are now taken over by the increasing requirements of our present customers. Because of our responsibility to them, this situation may continue quite a while.

We are sorry to say this because we enjoy making new friends. But we feel that we should tell those who might be interested in our engineering and manufacturing facilities, that for some time we may not be able to serve them.

Any change in the situation will be announced in this publication.

L. H. TERPENING COMPANY
DESIGN • RESEARCH • PRODUCTION
Microwave Transmission Lines and Associated Components
16 West 61st St. • New York 23, N. Y. • Circle 6-4760

VECO
VICTORY
Thermistors

ENGINEERS familiar with Western Electric thermistors will welcome this new source. Victory is licensed under all Western Electric thermistor patents.

These thermistors have exceptionally high temperature-coefficient and stability.

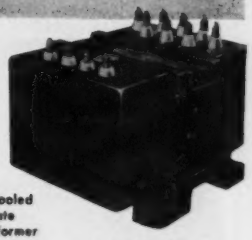
You may have used thermistors for time delay, temperature compensation, control, or measurement. Did you know they are being used for voltage regulation, volume limiting, surge protection, oscillator stabilization, radar power measurement, vacuum manometry, gas analysis, flow measurement, and a host of new applications being developed every day?

Send for free literature.

Victory
ENGINEERING CORPORATION
Springfield, New

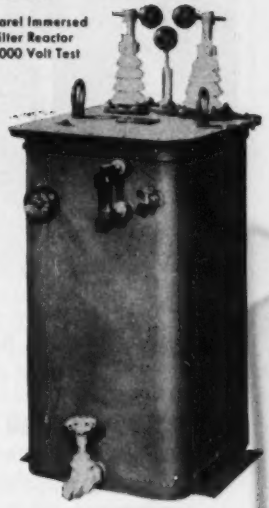
A NAME SYNONYMOUS WITH EXPERIENCE

MAGNATRAN

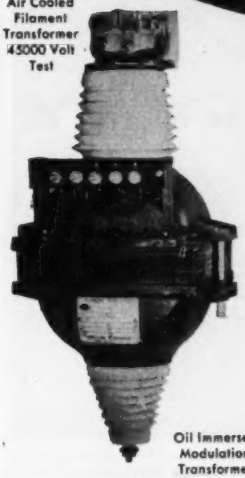


Air Cooled Plate Transformer

Askarel Immersed Filter Reactor 50000 Volt Test



Air Cooled Filament Transformer 45000 Volt Test



Oil Immersed Modulation Transformer

– all your large or high voltage magnetic equipment can now be supplied and co-ordinated by

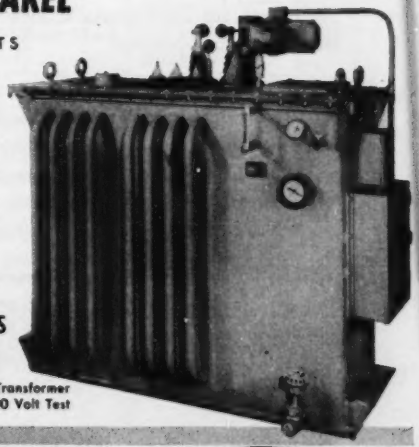
ONE DEPENDABLE SOURCE

Magnatran is operated by personnel having unusual and outstanding knowledge in the transformer engineering and manufacturing field. Thus Magnatran, a new name, is backed by reputation and experience requiring little further introduction to the industry. A partial list of Magnatran quality products is shown below. Submit your requirements for our informational details.

AIR... OIL... ASKAREL

MAGNATRAN PRODUCTS

PLATE TRANSFORMERS
FILAMENT TRANSFORMERS
FILTER REACTORS
MODULATION TRANSFORMERS
PULSE TRANSFORMERS
DISTRIBUTION TRANSFORMERS
TESTING TRANSFORMERS
PRECIPITATION TRANSFORMERS
GENERAL PURPOSE TRANSFORMERS
HI-VOLTAGE POWER RECTIFIERS



Askarel Immersed 3 Phase Plate Transformer
Motor Driven Tap Changer 50000 Volt Test

MAGNATRAN INCORPORATED

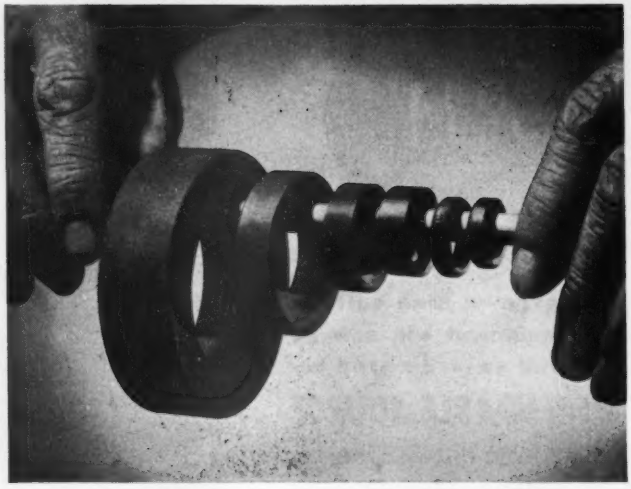
TRANSFORMERS AND ELECTRICAL EQUIPMENT

WALTER GARLICK, JR., PRESIDENT

246 SCHUYLER AVE., KEARNEY, NEW JERSEY

MAGNATRAN

POWDERED-IRON TOROIDS



3.375 in. outside diameter to 0.800 in.

PRECISION-MOLDED Lenkurt Toroids offer exceptional magnetic and temperature stability, extremely low losses and cross-modulation products. They are available in a variety of powdered-iron materials and on extremely short delivery schedules. Costs are low—thanks to new high-speed production facilities now in operation.

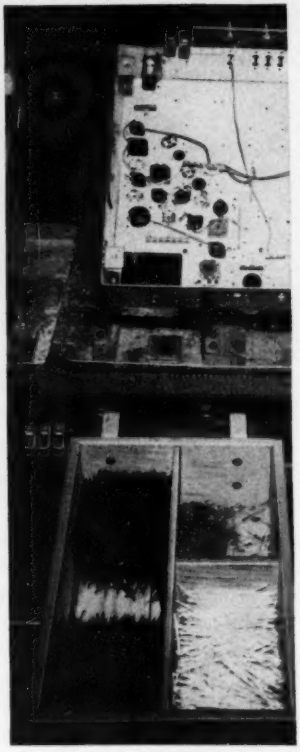
FIVE POPULAR SIZES of toroids are produced rapidly from existing dies, usually are available directly from stock. Lenkurt's magnetic-component engineering group is ready to solve special problems of inductor design, produce special sizes or types of toroids, as well as pot cores, cup cores, or tuning slugs to *your* specifications. *Send for further details.*

LET LENKURT QUOTE on your specific needs for: Toroidal coils — Filters — Powdered-iron cores — Specialized transformers — Variable inductors — and Toroidal transformers, made by Lenkurt Electric Company—*largest independent manufacturer of telephone toll transmission equipment.*

LENKURT ELECTRIC SALES COMPANY

Lenkurt

SAN CARLOS 1, CALIFORNIA



Use of plastic clothespins at top of chassis to indicate incomplete operation. Spare clips are snapped onto conveyor rail at left of small-parts tray

the top of the chassis, directly over the defect.

Each group of 10 to 20 operators is assigned the same color of clothespin. Operators within a group are numbered starting from 1, and their clothespins are correspondingly numbered in white ink. Since the joints and parts assigned to each operator are listed on master charts, the presence of a numbered clothespin on a chart isolates the defect to a small area for quick location by a repairman farther down the line. The clip is removed only after the unfinished work is done or the defect repaired.

No records are kept of clothespin-indicated defects since the operator catches them herself and they are generally not her fault. Inspectors on the line do make a record in duplicate of each inspection-detected error, however. One notation of the error goes on a slip

VOLTAGE REGULATED POWER SUPPLIES

For Industrial and Research Use

MODEL 815

B SUPPLY: 0-600 volts, 200 Ma.
C SUPPLY: 0-150 volts, 5 Ma.
FILAMENT SUPPLY: 6.3 volts AC, 10 Amp., CT.

DC POWER SUPPLY SPECIFICATIONS

REGULATION: ½% for both line (105-125 volts) and load variations.
REGULATION BIAS SUPPLIES: 10 millivolts for line 105-125 volts.
½% for load at 150 volts.
RIPPLE: 5 millivolts RMS.

VOLTS	CURRENT	MODEL
100-325 0-150 Bias 6.3 AC.CT.*	0-150 Ma. 0-5 Ma. 10 Amp.	131
200-500 6.3 AC.CT.	0-200 Ma. 6 Amp.	245
0-300 0-150 Bias 6.3 AC.CT.	0-150 Ma. 0-5 Ma. 5 Amp.	315
0-500 6.3 AC.CT.	0-300 Ma. 10 Amp.	500R
#1 200-500 #2 200-500 #3 6.3 AC.CT. #4 6.3 AC.CT.	0-200 Ma. 0-200 Ma. 6 Amp. 6 Amp.	510
0-500 0-150 Bias 6.3 AC.CT.	0-200 Ma. 0-5 Ma. 10 Amp.	515
#1 0-500 #2 0-500 #3 6.3 AC.CT. #4 6.3 AC.CT.	0-200 Ma. 0-200 Ma. 10 Amp. 10 Amp.	600

VOLTS	CURRENT	MODEL
0-500 0-150 Bias 6.3 AC.CT.	0-300 Ma. 0-5 Ma. 10 Amp.	615
#1 0-600 #2 0-600 #3 6.3 AC.CT. #4 6.3 AC.CT.	0-200 Ma. 0-200 Ma. 10 Amp. 10 Amp.	800
0-600 0-150 Bias 6.3 AC.CT.	0-200 Ma. 0-5 Ma. 10 Amp.	815
0-1000-Ripple 10 mv. 6.3 AC.CT.	0-50 Ma. 10 Amp.	1020
0-1200-Ripple 10 mv. 6.3 AC.CT.	0-20 Ma. 10 Amp.	1220
200-1000-Ripple 20 mv.	0-500 Ma.	1250
0-1000-Ripple 20 mv.	0-500 Ma.	1350
Specify your voltage and current requirements. Regulation available .5%, .1%, .01%.		SPECIAL SERIES

*All AC Voltages are unregulated. All units are metered except Models 131 and 315.

All units designed for relay rack mounting or bench use.

The Kepco Voltage Regulated Power Supplies are conservatively rated. The regulation specified for each unit is available under all line and load conditions, within the range of the instrument. Write for specifications.

MANUFACTURERS OF ELECTRONIC EQUIPMENT • RESEARCH • DEVELOPMENT

KEPCO LABORATORIES, INC.

149-14 41st AVENUE • FLUSHING, N. Y.

See the new Kepco Super Regulator at Booth 395-A, IRE Show

it's *Craftsmanship*

TYPE MC9 RANGE:
1.0 - 10.0 mc
Supplied per Mil type CR-5; CR-6; CR-8; CR-10 when specified.

TYPE AR23W RANGE:
0.080 - 0.19999 mc
Supplied per Mil type CR-15; CR-16; CR-29; CR-30 when specified.

Craftsmanship shows up when the going gets roughest. You can't see it but it's there—in every Bliley crystal.

Such basic quality ingredients as precision and stability depend upon *craftsmanship*. When you buy Bliley you get this extra assurance that can only be supplied by experience.

TYPE BH6A RANGE:
1.4 - 75.0 mc
Supplied per Mil type CR-18; CR-19; CR-23; CR-27; CR-28; CR-32; CR-33; CR-35; CR-36 when specified.

TYPE SR5A RANGE:
2.0 - 15.0 mc
Supplied per Mil type CR-1A when specified.

TYPE TCO-1
Temperature Control Oven.

TYPE BH7A RANGE:
15.0 - 50.0 mc
Supplied per Mil type CR-24 when specified.

Bliley
CRYSTALS

BLILEY ELECTRIC COMPANY
UNION STATION BUILDING
ERIE, PENNSYLVANIA

FOR HIGH-SPEED INDUSTRIAL SOLDERING

Use G-E Calrod* Soldering Irons

HERE'S WHY THEY ARE PREFERRED BY . . .

PRODUCTION MEN . . . because they are built tough for long, continuous production line soldering. With calorized or ironclad tips, they stay clean, solder fast and can be easily disassembled.

MANAGEMENT MEN . . . G-E irons last longer and need less service. Exhaustive tests by some of the world's largest soldering iron users show that G-E irons save them money.

MAINTENANCE MEN . . . because superior features, like the cord-strain insulator which withstands a pull of 35 pounds, makes far less maintenance necessary. When it's occasionally necessary, the dependable G-E cartridge heater slips right out for servicing—just pull a pin.

FOR FREE BULLETIN, GEA-4519, ask your nearby G-E distributor, or write to: Sect. 720-66, General Electric Co., Schenectady, New York.

*Registered Trademark

GENERAL ELECTRIC

720-66

Only with CO-AX

AIR SPACED ARTICULATED R.F. CABLES

Patents Regd. Trade Mark.

THE LOWEST EVER CAPACITANCE OR ATTENUATION

We are specially organized to handle direct enquiries from overseas and can give IMMEDIATE DELIVERIES FOR U.S.A. Billed in dollars. Settlement by your check.

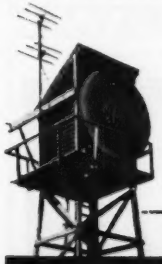
LOW ATTEN. Types.	IMPED. Ohms.	ATTEN. db/100ft. of 100 Mcs.	LOAD. C. Mmf.	O.D.	
A.1.	74	1.7	0.11	0.36	
A 2	74	1.3	0.24	0.44	
A 34	73	0.6	1.5	0.88	HIGH POWER FLEXIBLE
LOW CAPAC. Types	**CAPAC. mmf/ft.**	**IMPED. Ohms.**	**ATTEN. db/100ft. 100 Mc/s.**	**O.D.**	
C 1	7.3	150	2.5	0.36	
PC 1	10.2	132	3.1	0.36	PHOTOCELL CABLE
C 11	6.3	173	3.2	0.36	
C 2	6.3	171	2.15	0.44	
C 22	5.5	184	2.8	0.44	
C 3	5.4	197	1.9	0.64	
C 33	4.8	220	2.4	0.64	VERY LOW CAPACITANCE
C 44	4.1	252	2.1	1.03	

TRANSRADIO LTD
CONTRACTORS TO H.M. GOVERNMENT
138A CROMWELL ROAD LONDON SW7 ENGLAND
CABLES: TRANSRAD LONDON

WORKSHOP ANTENNAS

for SEA-SEARCH RADAR

Among the many military types being developed at the WORKSHOP are radar antennas for sea-search. The ship-borne antenna pictured here is being put through pattern tests on the Workshop range. This 3300-foot range — one of the longest in the country — is typical of WORKSHOP'S outstanding test facilities for military antennas.



Testing Range Transmitter
The transmitting tower is equipped with an 8-foot parabolic antenna and short wave radio for direct communication with the laboratory 3300 feet distant.

PARTIAL LIST OF
WORKSHOP
MILITARY ANTENNAS

- Radar Bombing
- Rocket or Guided Missile
- Radar Navigation
- Fire Control — Land or Sea
- Microwave Communications
- IFF Radar
- Radar Beacon

CONTRACT SERVICE

RESEARCH
ENGINEERING
PRODUCTION

A complete antenna laboratory, staffed by experienced engineers using modern equipment, and the largest production facilities in the industry are available through Workshop. Both Government and industry make extensive use of Workshop for antenna research, design, and production.

The
WORKSHOP ASSOCIATES
DIVISION OF THE GABRIEL COMPANY
Specialists in High Frequency Electronics
135 Crescent Road, Needham Heights 94, Massachusetts

MEMBER OF AGMA

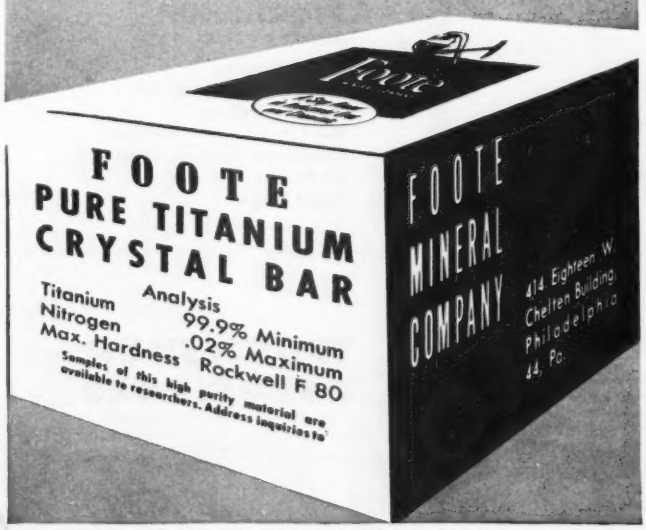
● If your requirements are for extra fine-pitch gears and pinions with precision tolerances, send us your prints for quotation. Beaver Gear engineers are trained to assist you in the design and application of this type gear. Our workmen are specialists in manufacturing small and medium size, fine and extra fine-pitch gears to your most exacting specifications.

THE *Finest* IN GEARS

Beaver Gear Works Inc.

1021 PARMELE STREET, ROCKFORD, ILLINOIS

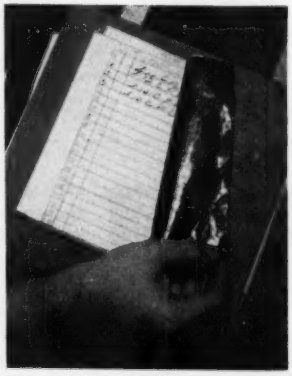
NOW AVAILABLE
in Research Quantities


FOOTE
PURE TITANIUM
CRYSTAL BAR
Analysis
Titanium 99.9% Minimum
Nitrogen .02% Maximum
Max. Hardness Rockwell F 80
Samples of this high purity material are available to researchers. Address inquiries to
FOOTE MINERAL COMPANY
414 Eighteen W. Chelten Building Philadelphia 44, Pa.

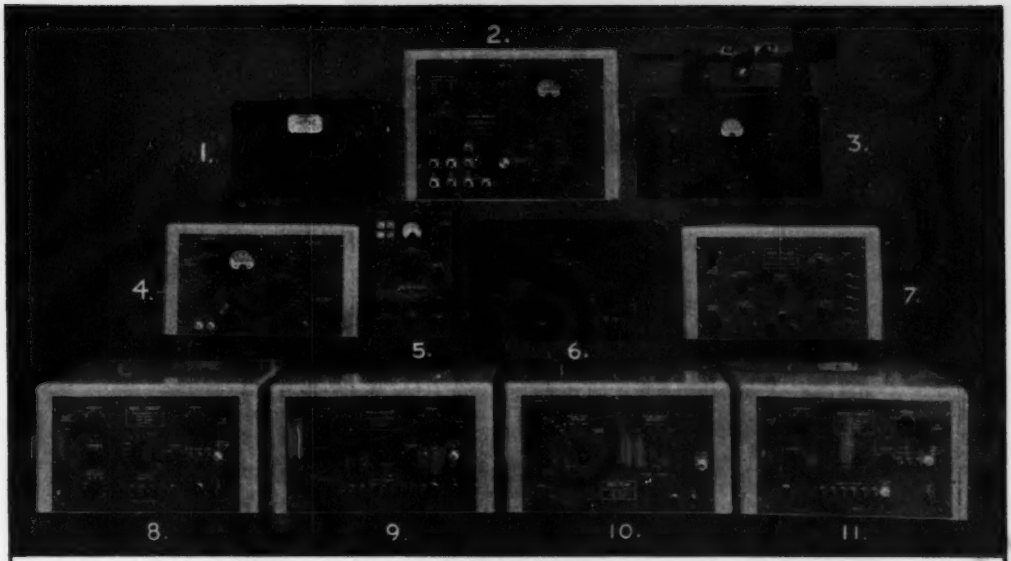
Inspector makes notation of error on small slip of paper that goes inside the chassis

of paper that rides with the chassis from the first inspection position on. The carbon impression goes on a master record kept by the inspector. Each notation includes the number of the responsible operator, so that an incipient epidemic of similar errors can be detected and halted.

The photographs show the method used for obtaining a master record on a single sheet while writing on many different slips. The master record sheet and carbon paper are held in position on a writing board by a spring clip. The 20 lines on the master sheet are numbered from 1 to 20, and the line number is crossed out each time a line is used. When an error is detected, the inspector takes the error slip out of the chassis and holds it over the carbon in such a way that



Copy of error notation appears on next available line of master record sheet



THESE VERSATILE INSTRUMENTS CAN HELP YOU

1. MEGA-NODE SR.

A calibrated random noise source, 100-3000 mcs. Reads noise figure directly on panel meter.

2. MEGA-MATCH UHF Model

Displays reflection coefficient over 30 mc band from 10 to 1000 mcs.

3. MEGA-X

An X-band Signal Source, C.W. or Sweeping 8500 to 9700 mcs.

4. CALIBRATED MEGA-SWEEP

Wide range sweeping oscillator with single dial tuning.

5. ROTALYZER Model WB

Accurate measurements of instantaneous and average RPM as well as torsional vibration.

6. MARKA-SWEEP Model RF-P

An all-electronic sweep generator switch tuned to VHF TV channels. Narrow crystal-positioned pulse-type markers.

7. RADA-PULSER

A pulsed carrier generator for transient response testing of Radar IF amplifiers.

8. KILO-SWEEP

Narrow band sweep from 50 kc to 2 mc with crystal markers.

9. RADA-SWEEP

A wide band sweep generator with markers for aligning Radar IF amplifiers.

10. MEGA-PULSER

Ultra narrow pulse generator.

11. MARKA-SWEEP Model Video

Wide Range video sweep generator covering 50 kc to 20 mc in three bands with crystal markers.

OTHER INSTRUMENTS *(Not Illustrated)*

- **SONA-SWEEP** — Narrow band sweep from 5 kc to 200 kc with crystal markers.
- **MICROWAVE MEGA-MATCH** — Displays reflection coefficient over 30 mc band from 8500 to 9700 mcs.
- **MEGALYZER** — Sensitive visual RF voltmeter and spectrum analyzer.
- **MEGA-NODE** — A calibrated random noise source; 3-220 mc. Reads noise figure directly.
- **MICROWAVE MEGA-NODES** — Calibrated noise sources at microwaves.
- **MICRO-PULSER** — Provides pulses of selectable width over a wide range of repetition rates.
- **MEGA-PIX** — A crystal controlled TV picture and sound RF signal source.
- **ATTENUATORS** — High frequency switchable attenuators.
- **VIBRALYZER** — A vibration and noise frequency analyzer.
- **SONA-GRAPH** — A sound spectograph for the frequency analysis of audio energy.

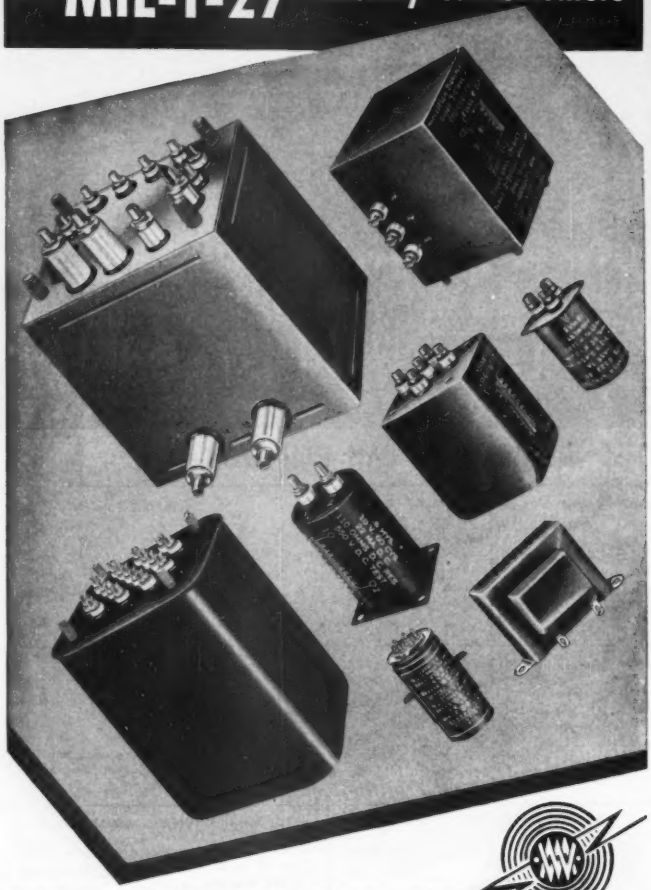
★ WRITE FOR CATALOG and PRICES

KAY

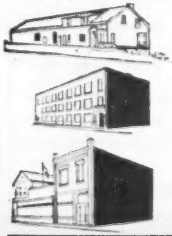
KAY ELECTRIC COMPANY

25 Maple Avenue — Phone CAldwell 6-4000 — Pine Brook, New Jersey

3 Plants Geared for Production of MIL-T-27 Military Transformers



YOU GET THE BEST FROM MID-WEST



We are geared for production of fully-approved, MIL-T-27 Transformers and Filter Reacters to meet Military specifications. Our Production includes: HYPERSIL®, or Nickel alloy materials in Hermetically sealed or Fosterite® type transformers.

MIDWEST'S modern plants are staffed by experienced personnel employing the latest equipment and electronic knowledge to produce components of consistent quality for Military and Civilian use.

WE INVITE PRIME AND SUB-CONTRACT INQUIRIES

MID-WEST COIL & TRANSFORMER CO.
1642 NORTH HALSTED STREET • CHICAGO 14, ILLINOIS
Branch Offices: New York City 270 La Fayette St. · Buffalo (Kenmore) 278 Hamilton Blvd. · Plymouth, Indiana 805 Pennsylvania

smaller than a suitcase

. . . and almost as portable!

AMERICAN ELECTRIC
400 Cycle
MOTOR ALTERNATOR

WEIGHT: Approx 125 lbs.
SIZE: 22" x 12" x 12"

Designed for production and laboratory high frequency power supply requirements. STRONG—SIMPLE—INDESTRUCTIBLE CONSTRUCTION—No delicate moving parts, brushes or springs to wear out or maintain.

Replaces single large, hard-to-get H-F power supply serving multiple purposes . . . *A bank of these compact, flexible units costs far less, provides individual portable power sources for each project, avoids downtime hazards of single unit!*

Meets power supply requirements for AN-E-19 equipment.

OUTPUT: Up to 1000 Watts single phase 115V or up to 1800 Watts three phase 115/200V. Input: 60 cycle AC.

Total harmonic content under 5%; ± 1% voltage regulation.

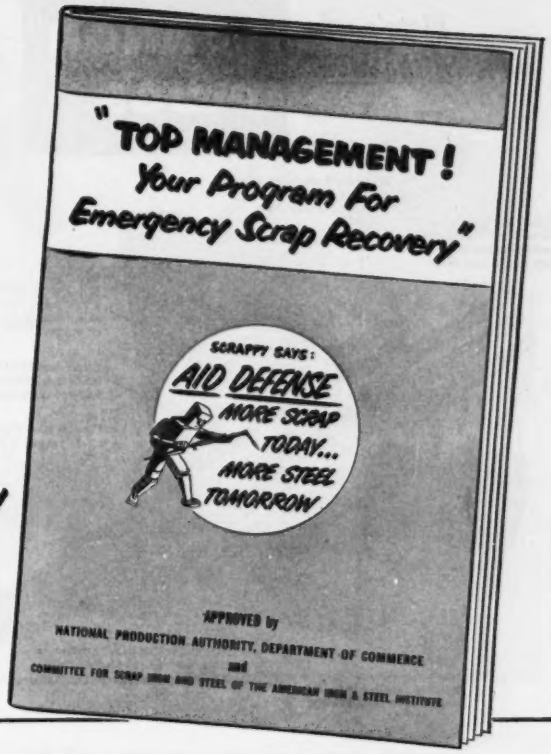
WRITE FOR DETAILS!

Larger capacities available.

AMERICAN ELECTRIC MOTORS
4911 Telegraph Rd. Los Angeles 22, California

What YOU can do... Must do

to ease the critical iron and steel scrap problem


"TOP MANAGEMENT! Your Program For Emergency Scrap Recovery"
SCRAPPY SAYS:
AID DEFENSE
MORE SCRAP TODAY... MORE STEEL TOMORROW
APPROVED by
NATIONAL PRODUCTION AUTHORITY, DEPARTMENT OF COMMERCE
and
COMMITTEE FOR SCRAP IRON AND STEEL OF THE AMERICAN IRON & STEEL INSTITUTE

It's a problem calling for the assistance of every thoughtful business man—now.

Unless the steel mills get more scrap . . . furnaces may have to be shut down.

Shut down—at a time when our armed forces need more and more equipment . . . when civilian demands for steel are greater than ever . . . when our economy is fighting desperately against inflation!

You Can Help. Yes . . . regardless of the business you're in . . . you're in the scrap business, too.

If you're in the steel-fabricating business, you have extra *dormant* scrap to be added to your *production* scrap.

If you're in any other business, you surely have idle metal that will do you—and America—more good being fed into furnaces than cluttering up your premises.

Write for Suggestions. The booklet shown here tells how to set up a Scrap Salvage Program with least amount of effort and minimum interference with your regular operation. It tells where to look for scrap, what to do with it when you get it.

You are urged to send for the booklet now. Use the coupon.

FACTS ABOUT SCRAP SALVAGE

Steel production	1950 — 97,800,000 net tons
Estimated capacity	1952 — 119,500,000 net tons
Purchased scrap used*	1950 — 29,500,000 gross tons
Estimated purchased scrap requirement*	1952 — 36,200,000 gross tons

*All consumers

Where will the extra tonnage come from? Mostly from your *dormant* metal—obsolete machines and structures, tools, jigs, fixtures, gears, wheels, chains, track.

NON FERROUS METAL NEEDED, TOO!

A PUBLIC SERVICE PROJECT — THE ADVERTISING COUNCIL

This advertisement is a contribution, in the national interest, by

McGRAW-HILL PUBLISHING COMPANY, INC.

330 WEST 42nd STREET — NEW YORK 18, N. Y.

Advertising Council
25 W. 45th St.
New York 19, N. Y.

Please send me a copy of the free booklet: "Top Management: Your Program for Emergency Scrap Recovery"

NAME.....

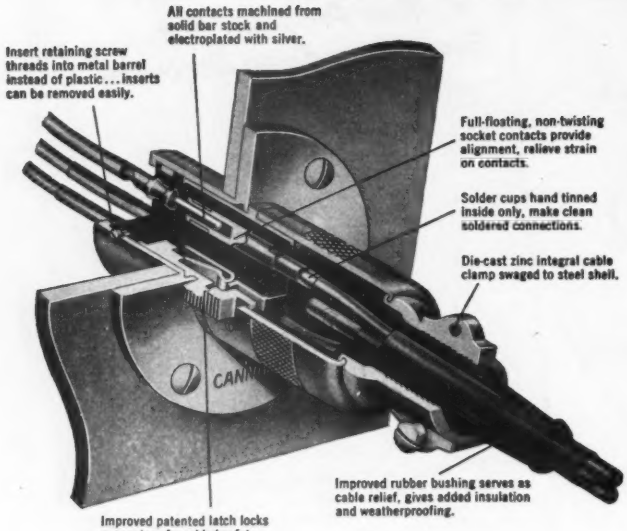
COMPANY..... TITLE.....

ADDRESS.....

CITY..... ZONE..... STATE.....

Here's why those in the know —demand

CANNON PLUGS


All contacts machined from solid bar stock and electroplated with silver.
Insert retaining screw threads into metal barrel instead of plastic... inserts can be removed easily.
Full-floating, non-twisting socket contacts provide alignment, relieve strain on contacts.
Solder cups hand tinned inside only, make clean soldered connections.
Die-cast zinc integral cable clamp swaged to steel shell.
Improved rubber bushing serves as cable relief, gives added insulation and weatherproofing.
Improved patented latch locks connectors for added safety.

If you talk to sound technicians anywhere you'll find Cannon Type P connectors are the accepted standard of quality... taking a beating day in day out where frequent changes in circuits are required on all kinds of jobs up to 30 amp. capacity.

The close attention to important details called out in the above illustration is typical of the care used in the design and construction of all Cannon Plugs—the world's most complete line.

The above type series is distributed through selected franchise distributors. The line is fully described in the Type P Bulletin. Engineering bulletins describing each of the many basic types of Cannon Plugs will be sent on request.

P-3

P-8

Type P insert arrangements include 2-3-4-5-6 and 8 contacts. All contacts are 30 amp. capacity except those in P-8 layout which are 15 amp. Full scale layouts, front view pin insert, engaging side, shown at right.

CANNON ELECTRIC

Since 1915

CANNON ELECTRIC COMPANY
LOS ANGELES 31, CALIFORNIA

Factories in Los Angeles, Toronto, New Haven. Representatives in principal cities. Address inquiries to Cannon Electric Company, Department C-120, P. O. Box 75, Lincoln Heights Station, Los Angeles 31, California.

Method of supporting writing board on conveyor line and storing spare sheets

its next empty line is opposite the first not-crossed-out line number on the master record. For each error, the number of the responsible operator is also written down. Errors are abbreviated or coded; thus, S 10 C P C means miniature socket No. 10 center pin is cold soldered.

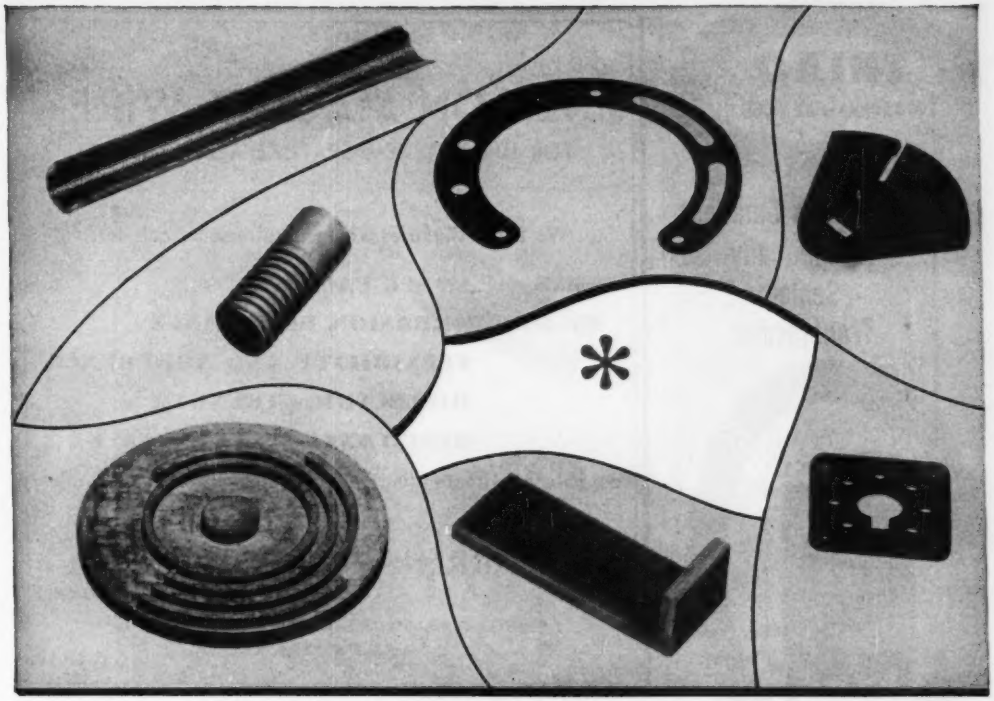
The writing board is hinged to a metal tray that hooks over the near rail of the conveyor and holds a pan in which spare pencils and master record sheets are stored. Spring clips on the board itself hold the pencil being used. Boxes for small parts needed during assembly-line operations have similar strap-iron hooks going over the conveyor rail.

High-Speed I-F Alignment

FAST ALIGNMENT of i-f transformers in receivers calls for some means of attenuating the signal quickly or automatically as the trimmers are peaked.

On Emerson's three-way portable line, attenuation is achieved by pulling the chassis away from a signal-radiating loop with the left hand while adjusting the trimmers with a tool in the right hand. An operator quickly learns to synchronize the movement of the chassis with the change in volume of the modulated signal coming from the speaker on the chassis.

Signals from a central signal cage are fed to a master attenuator box at the alignment position. Here a selector switch gives a choice of



to solve the shortage puzzle

replace key pieces with *Lamicoid®

High Dielectric Strength
Low Power Factor
Heat Resistance
Low Moisture Absorption
High Impact Resistance
Dimensional Stability
Light Weight
Tensile Strength
Resistance to Abrasion

LAMICOID, a thermosetting plastic laminate, has already proved itself for such uses as terminal blocks, panels, dials and many other applications.

The same qualities that make it adaptable to these uses may also provide practical answers to your material shortage problems . . . and perhaps even bring you savings or improvements!

For example, you can obtain LAMICOID in a wide variety of forms and grades which are almost certain to possess the exact characteristics your product requires. This versatility is possible because LAMICOID is produced through the use of many different fillers such as glass, nylon, fabric, paper, etc. with a variety of resins.

LAMICOID is supplied in standard sheets, rods and tubes, or fabricated into parts to your specification. We will be pleased to put our 58 years of experience to work on *your* electrical insulation problems. Send your blueprints and specifications today for a prompt quotation.

MICA *Insulator* COMPANY

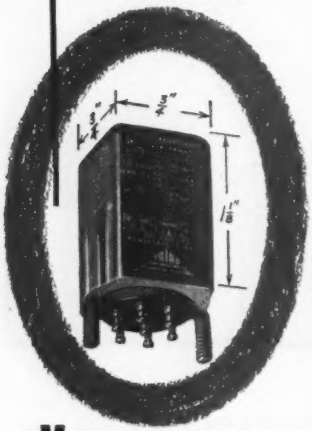
Schenectady 1, New York

Offices in Principal Cities

LAMICOID (Laminated Plastic) • MICANITE (Built-up Mica) • EMPIRE (Varnished Fabrics and Paper) • FABRICATED MICA

TRIAD announces

the World's Smallest Hermetically Sealed Transformer



Voice Frequency Audio Transformers of all low-powered types are now available in MIL standard AF case as shown above. Production is limited, but we will be glad to quote on quantities to meet your requirements.

These transformers are available only for use on military contracts.

NOTE: We are tooled for the production of terminals and cases for this transformer. Write for prices.

For specifications and prices on other Triad transformers, write for Catalog TR-51.

TRIAD TRANSFORMER MFG. CO.

2258 Sepulveda Blvd.
Los Angeles 64, Calif.

TEFLON MAGNET WIRE

FOR HIGHEST TEMPERATURE APPLICATIONS

We invite inquiries where requirements call for:

small SPACE FACTOR
HIGHEST ABRASION RESISTANCE
FLEXIBILITY AND ADHERENCE
DIELECTRIC STRENGTH
RESISTANCE TO CHEMICALS

capable of withstanding temperatures of 250 centigrade.

WARREN WIRE COMPANY

POWNAL VERMONT

Producers of Nylon, Plain Enamel, and Served Magnet Wire
Tinned and Bare Copper Wire.

Bardwell & McAlister's Line of Television Lights

TV SPOTS • Designed for Television Studios and Stages

Drawing upon their sixteen years of experience in the production of studio lights used by the motion picture industry, Bardwell & McAlister, Inc. now offers a complete new line of lights especially designed and engineered for TV stage and studio lighting.

Paint with Light

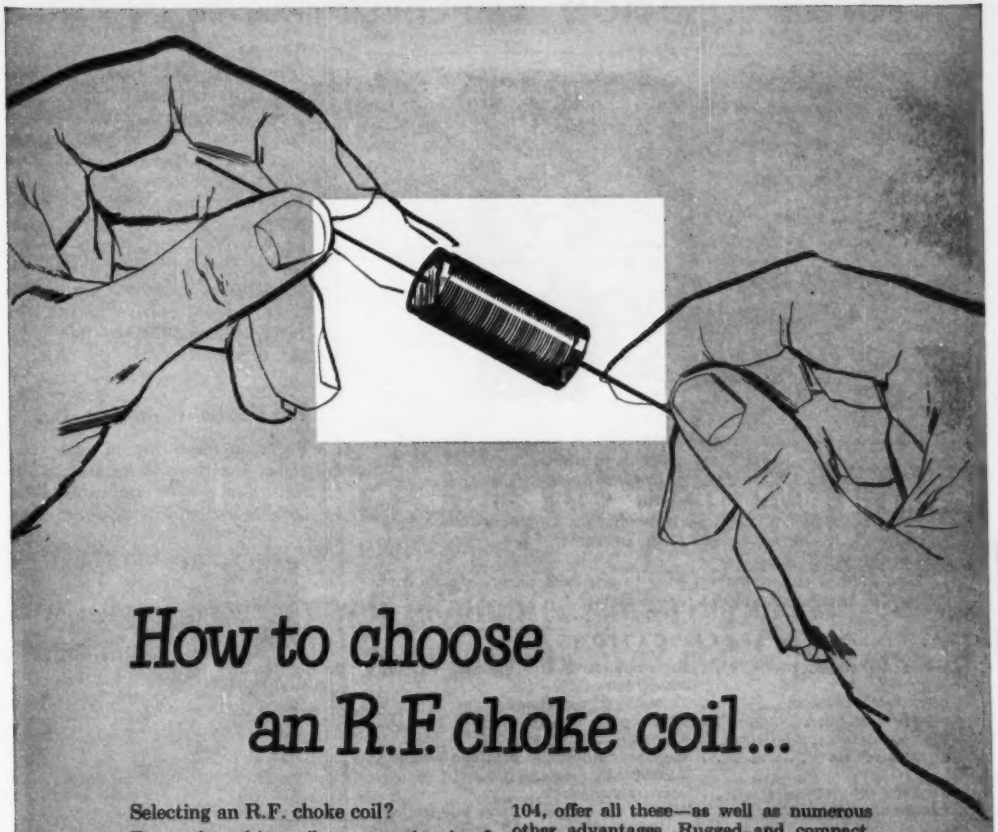
Painting with light is the ability to control the light source, in order to emphasize the necessary highlights and the all-important shadows. Only through controlled light can the scene or subject be given the desired brilliance, beauty and third dimensional effects.

Our Specialists...

are always ready to assist and advise your engineering staff, so that your studios and stages will be fully equipped to properly "Paint with Light."

Write for complete specifications and prices of these TV SPOTS. Address Dept. 68.

BARDWELL & McALISTER 2950 ONTARIO STREET BURBANK, CALIFORNIA



How to choose an R.F. choke coil...

Selecting an R.F. choke coil?

Remember this: coil construction is of primary importance.

Insulated copper wire, for example, is superior to bare wire for the windings. Rugged, molded jackets give longer service than those fastened by glue or other means. Windings soldered to leads, and the elimination of shorted end-turns mean better all round performance.

Jeffers R.F. choke coils, types 101, 102 and 104, offer all these—as well as numerous other advantages. Rugged and compact, they assure uniform results, even under the most difficult circuit conditions.

Jeffers coils are available in such a wide range most laboratories no longer assemble their own. Instead, they carry a full assortment and select from stock, as needed. Results: lower costs, time saved, greater standardization.

Write today for our specification sheets.

JEFFERS ELECTRONICS

Jeffers Electronics, Inc.
Du Bois, Pennsylvania
A Subsidiary of Speer Carbon Co.

Other Jeffers Products

ceramic capacitors • disc capacitors
high voltage condensers • capristors

Other Speer Products for the Electronics Industry

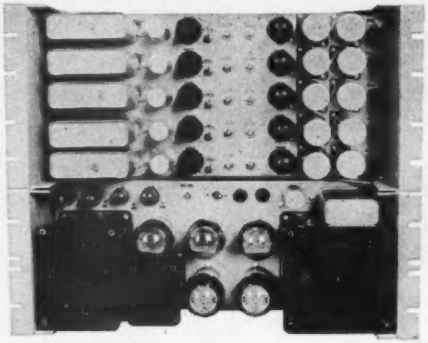
anodes • contacts • resistors • iron cores
discs • brushes • molded notched* coil forms
battery carbon • graphite plates and rods

*Patented

Other Speer Subsidiaries: Speer Resistor Corp., International Graphite & Electrode Corp.

VIDEO DISTRIBUTION AMPLIFIER

TYPE 1311



TYPE 1311 Video Distribution Amplifier is specifically designed to distribute video or synchronizing signals to several outlets. Thus, five separate equipments can be fed from a single synchronizing signal generator and monoscope combination.

The high degree of isolation between each output and each input circuit prevents interaction, even in the event of a short circuit at any one of the output lines.

Type 1311 is also commonly used to distribute picture signals from TV studios to a number of different locations.

SPECIFICATIONS

INPUT IMPEDANCE:	High impedance, for bridging 75 ohm coaxial lines.
OUTPUT IMPEDANCE:	To match 75 ohm lines.
INPUT VOLTAGE:	2 Volts peak to peak.
VOLTAGE GAIN EACH CHANNEL:	Adjustable from 0.9 to 1.1.
OUTPUT POLARITY:	Same as, or opposite of, input polarity, selectable by toggle switch.
NUMBER OF CHANNELS:	5 separate channels.
FREQUENCY RESPONSE:	Pass 60 cycle square wave undistorted. No overshoot on 100 KC square wave Down 3 DB @ 11 MC. Down 6 DB @ 13 MC.
CONNECTORS:	Both the input and output circuits use PL-259 coaxial line connectors which are not supplied.
POWER SUPPLY:	105-125 Volts, 60 cycle, single phase, 250 watts.
FINISH:	Natural sandblasted aluminum.
WEIGHT:	Amplifier: 17 lbs. net. Power Supply: 35 lbs. net.
PRICE:	$550.00 F.O.B. Plant (including power supply as illustrated).

Complete specifications available on request.

ELECTRONIC DEVELOPMENT, ENGINEERING and PRODUCTION:

Our reputation for producing top quality precision electronic equipment qualifies us as a reliable and capable subcontractor for manufacturers currently holding primary defense orders. Inquiries will be given our immediate attention.

Manufacturers of a complete line of TV and Radar Test Equipment

TIC Tel-Instrument Co. Inc.

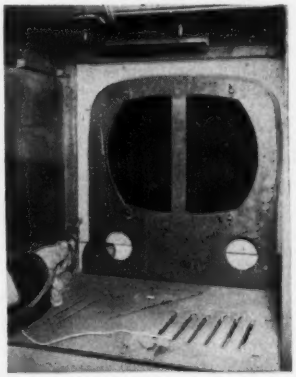
50 PATERSON AVENUE • EAST RUTHERFORD N. J.

455, 600, 1,450 and 1,620 kc, and screwdriver-type attenuators permit setting the maximum level at which each signal is fed to a fixed loop antenna at the rear of the bench. The selected signal radiates directly into the receiver circuits, as the set's own loop has not yet been connected. A hard maple bench surface is used so the chassis will slide easily back and forth. Trol-E-Duct permits warming up the sets a few minutes on the conveyor belt that brings them into the alignment cage.

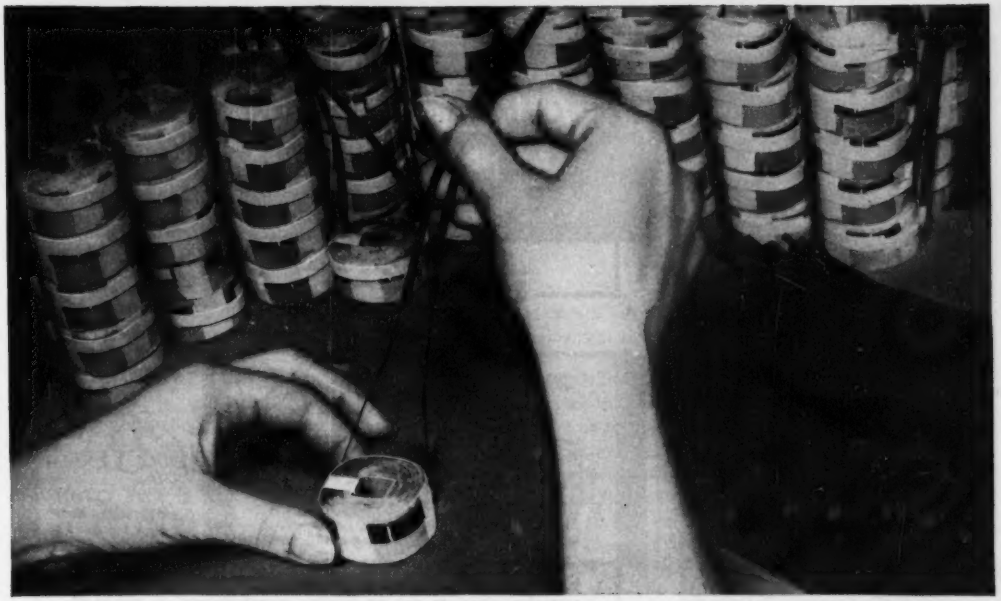
TV Chassis-Centering Jigs

PRECISION centering of each television chassis with respect to the picture-tube mask while installing both in cabinets is achieved with

STEP 1: Placing plastic mask on mask-centering jig. Projecting pipes fit into control holes in cabinet



STEP 2: Fastening mask to wood cabinet with wood screws, using air-operated screwdriver. Pipes on jig project into cabinet holes for controls, centering mask accurately with respect to these holes



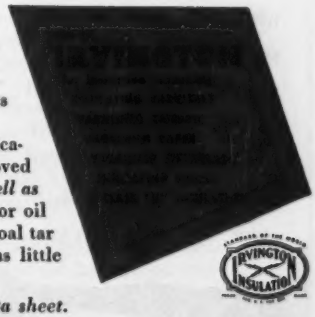
Minneapolis-Honeywell eliminates soldering operations . . . by slipping TEMFLEX 105 over coil leads

Quantity use of Temflex 105 flexible plastic tubing effects substantial savings in assembly costs of the RA 117 Protectorelay oil burner control, according to Minneapolis-Honeywell Regulator Company, makers of the famous MH Control Systems and Brown Instruments.

Assembly of the control calls for suitable insulation of two lead wires from each of two coils of the type shown in the illustration. Conventional methods would call for clipping off the lead wires close to the coils, and making soldered joints to insulated wires — calling for four soldering operations for each control.

But Minneapolis-Honeywell merely slips a length of Temflex 105 over each lead. RESULT: Soldering operations are eliminated . . . leads are thoroughly insulated, remain flexible . . . assembly costs are cut down.

Service advantages of Temflex 105 — in this and many other applications — are even more outstanding. This Irvington tubing is approved by Underwriters' Laboratories for 90° C operation in oil — *as well as* for continuous operation at 105° C. In addition to this superior oil resistance, Temflex 105 offers good resistance to mineral and coal tar solvents — and prolonged exposure to acids and alkalies has little effect on its initial high dielectric strength of 1200 vpm.



Get the full facts on Temflex 105 — mail the coupon for free technical data sheet.

EL-1/52

Send this convenient coupon now

Irvington

VARNISH & INSULATOR COMPANY

Irvington 11, New Jersey

Plants: Irvington N. J.; El Monte, Calif.; Hamilton, Ontario, Canada

Irvington Varnish & Insulator Co.
6 Argyle Terrace, Irvington 11, N. J.

Gentlemen:

Please send me your technical data sheet on Temflex 105 Plastic Tubing.

Name.....Title.....

Company.....

Street.....

City.....Zone.....State.....

For Further Information, Consult pages 92-93 in the 1951-1952 Electronics Buyers' Guide

He does more than carry the fullest possible stock for promptly filling your needs. He has a wealth of data at his finger-tips on the applications and correct use of precision screws, dowel pins and pipe plugs. He wants to serve, as well as sell you.

WARNING
Allen-Type screws don't necessarily Allen-Made. Get genuine "Presser-Formed" Allen Head screws in this black and silver box.

INSULATION
FORMVAR • FORMEX • ENAMEL

STRIPPED CLEAN IN SECONDS

with X-VAR

X-VAR is non-corrosive, non-creeping — leaves wire ready for soldering. Now in use by leading manufacturers of electrical products. Write for FREE SAMPLE for testing.

FIDELITY CHEMICAL PRODUCTS CORP.
472 Frelinghuysen Avenue, Newark 5, New Jersey

POTENZIOMETRI · POTENTIOMETRES · POTENTIOMETERS · POTENCIOMETROS
LESA manufacture potentiometers for all requirements. With 20 years research and experience behind us, our products are known and recognised for their quality throughout the world. Write for complete information and catalog.
LESA
MILANO
(ITALY) VIA BERGAMO, 21

Double Barrel Advertising

Advertising men agree – to do a complete advertising job you need the double effect of both Display Advertising and Direct Mail.

Display Advertising keeps your name before the public and builds prestige.

Direct Mail supplements your display advertising. It pin-points your message right to the executive you want to reach – the person who buys or influences the purchases.

More and more companies are constantly increasing their use of Direct Mail because it does a job that no other form of advertising will do.

McGraw-Hill has a special Direct Mail Service that permits the use of McGraw-Hill lists for mailings. Our names give complete coverage in all the industries served by McGraw-Hill publications – gives your message the undivided personal attention of the topnotch executives in the industrial firms. They put you in direct touch with the men who make policy decisions.

Some people have a wrong conception of Direct Mail. There's no hocus-pocus to it—there's no secret formula—nor is there need for an extensive department to plan and execute your mailing program. You don't even need your own mailing lists.

Probably no other organization is as well equipped as McGraw-Hill to solve the complicated problem of list maintenance in industrial personnel. Our lists are compiled from exclusive sources, based on hundreds of thousands of mail questionnaires and the reports of a nationwide field staff, and are maintained on a twenty-four hour basis.

In view of present day difficulties in maintaining your own mailing lists, this efficient personalized service is particularly important in securing the comprehensive market coverage you need and want.

Ask for more detailed information today. You'll be surprised at the low over-all cost and the tested effectiveness of these hand-picked selections.

McGRAW-HILL
PUBLISHING COMPANY, INC.
330 WEST 42nd STREET, NEW YORK 18, N. Y.

for better marking use

MARKEM®

FOR MARKING PRODUCTS, PARTS, PACKAGES, TAPES, TAGS, LABELS — FLAT, CURVED, IRREGULAR SURFACES

THE MARKEM METHOD

Markem machines, types, and inks constitute a better method for marking the products of industry. Markem equipment is engineered to solve special marking problems. Behind the Markem method lies nearly half a century of marking experience which may be applied to your marking problem.

MARKEM MARKING MACHINES

There is a Markem marking machine for practically every marking purpose — for *direct marking* of product packages, products, and product parts — for *imprinting* labels, tags, tapes, and special gummed, pressure-sensitive or heat-seal backed material, or for producing *complete labels*. Makes up to many thousand durable imprints per hour on almost any kind of material. No special skill needed to operate. Legend and color of imprint quickly and easily changed.

MAKE YOUR MARK WITH MARKEM

Whether you make saws or sox, spark plugs or shoes, TV tubes or tachometers, drugs or hand grenades — whatever your marking problem — find out how easily and economically the Markem method can handle it. Just send a sample of the item to be marked and details of your needs to Markem Machine Company, Keene 5, New Hampshire.

MARKEM
BETTER MARKING SINCE 1911

Rate Measuring
GYROSCOPES
for
Control
Stabilization
Flight Testing
Rate Computation

For the accurate measurement of absolute rates of angular rotation, the Doelcam Model K Rate Measuring Gyroscope offers the following features:

1. Accuracy: 0.5%
2. Resolution: 0.1%
3. Maximum uncertainty: 0.2%
4. Hermetically sealed
5. Shock and vibration resistant
6. Microsyn pickoff: 60 — 5,000 cps
7. Thermostatically controlled damping ratio
8. Small size: 3 inches diameter x 5.62 inches
9. Lightweight: 3 5/8 lbs.

The design of the Model K Gyroscope affords wide latitude in the adjustment of parameters and permits design to any particular specifications.

For complete details write for Bulletin K

DOELCAM CORPORATION 36 Elmwood Street Newton 58, Massachusetts

GYROSCOPIC FLIGHT TEST AND CONTROL INSTRUMENTATION

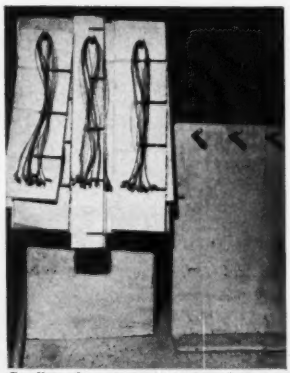
SYNCHROS · SERVOMECHANISMS · MICROSYNS · ELECTRONIC INVERTERS

STEP 3: Using wood pegs to center chassis with respect to holes for controls, while another operator pushes chassis into cabinet from rear. Holes in pegs fit control shafts

simple-to-use jigs in Emerson's Jersey City plant. The accompanying illustrations show the three steps involved.

Tangle-Preventer

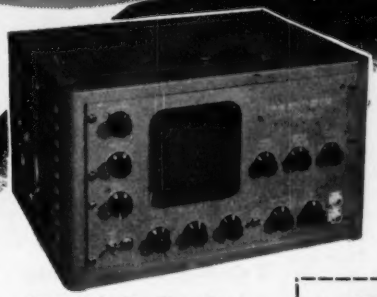
To PREVENT dial cords from tangling on peg boards, Emerson methods engineers introduced a system of placing strips of scrap corrugated cardboard on the pegs between groups of ten cords. When a board is completely loaded, a three-hole strip is placed horizontally over the pegs to hold the cords on.



Cardboard separator strips between groups of ten dial cords minimize tangles when operator has to grab and install cord on three-way-radio production line having 20-second time cycle

PANORAMIC
RADIO PRODUCTS, INC.

SETS THE PACE
IN SPECTRUM ANALYSIS
FROM AUDIO TO MICROWAVE FREQUENCIES



Collect data more quickly and easily with Panoramic's graphic assistance. You will find that these fine instruments are unexcelled for laboratory, research and production applications requiring spectrum or waveform analysis.

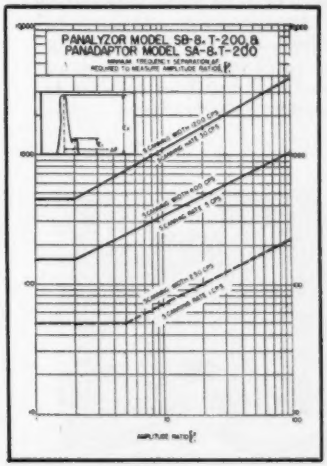
Whatever your problem—there is a Panoramic analyzer to answer your needs for analyzing waveform distortions, noises, characteristics of AM, FM or pulsed signals, vibrations, spurious oscillations or modulation, response characteristics of filters or transmission lines or monitoring many frequency channels simultaneously.

More Valuable Than Ever!

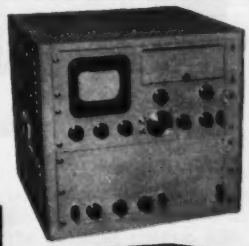
PANADAPTOR SA-8a PANALYZOR SB-8a

New Panoramic engineering achievements embodied in these improved instruments open important new applications involving modulation and interference problems.

- IMPROVED RESOLUTION DOWN to 50 CPS for RF spectrum analysis where maximum resolution is a "must"
- LOW SWEEP RATES DOWN TO 1 SCAN PER SECOND for analysis of pulsed RF signals with low p.r.f.'s
- LONG PERSISTENCE DISPLAYS
- CONTINUOUSLY VARIABLE SCANNING WIDTH



PANORAMIC SONIC ANALYZER, MODEL LP-1
for increased harmonic resolution in high speed audio waveform analysis.



20 KC log scale provides a complete visual spectrograph of the sonic spectrum from 40 to 20,000 cps. A tuning control and a three-step scanning range selector permit selection and magnification of any spectrum segment for sharp, detailed analysis.

Selectable Linear Scanning Ranges
Pre-adjusted Optimum Resolution

Scanning Range	Resolution
100 cps	20 cps
500 cps	33 cps
1500 cps	100 cps

PANORAMIC ULTRASONIC ANALYZER, MODEL SB-7
Direct Reading Spectrum Analyzer

Invaluable for channel monitoring, telemetering, medical studies; and for investigating ultra audible noises and vibrations. The SB-7 allows overall observation of 200KC wide band or highly detailed examination of selected narrow bands.

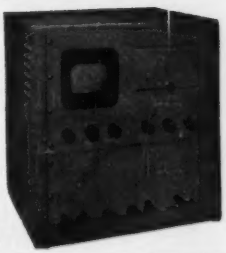
Frequency Range: 2KC-300KC, linear scale
Scanning Width: Continuously variable, 200KC to zero
Amplitude Scale: Linear and two decade log
Input Voltage Range: 500m V.—50 V.
Resolution: Continuously variable from 2KC to better than 500 CPS.

PANORAMIC SONIC RESPONSE INDICATOR G-2
for More Accurate Frequency Response Measurement

Used with Models AP-1 or LP-1, the G-2 allows visual inspection of the amplitude vs. frequency characteristic of systems in the range between 40 and 20,000 cps. May be used for research, etc.

- Linear or log (60 db range) amplitude scale
- Slow, 1 cps sweep rate
- 10-step attenuator with 100 db range selects output voltages between 50 microvolts and 5 volts
- 3 selectable output impedances: 100 ohms; 500 ohms; 3000 ohms

PANORAMIC SONIC ANALYZER, MODEL AP-1
Automatic Waveform Analysis in Only 1 Second



Here is your answer for truly simple high speed analysis of vibrations, harmonics, noises, acoustics and intermodulation under static or dynamic conditions. The AP-1 automatically separates and measures frequency and magnitude of complex audio wave components.

Frequency Range ..... 40-20,000 cps, log scale
Input Voltage Range..... 500mV-500V
Voltage Scale ..... Linear and two decade log
Resolution ..... Optimum throughout frequency range.

PANORAMIC
RADIO PRODUCTS, INC.

10 SOUTH SECOND AVENUE, MOUNT VERNON, N. Y.

WRITE TODAY FOR COMPLETE SPECIFICATIONS AND PRICES.

SEE THE COMPLETE LINE OF PANORAMIC INSTRUMENTS DYNAMICALLY DEMONSTRATED AT THE IRE SHOW • Booth N-6.

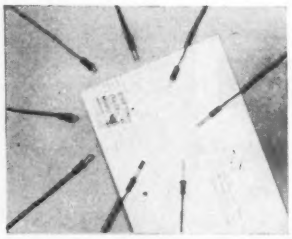
NEW PRODUCTS

Edited by WILLIAM P. O'BRIEN

Tube and Component Specifications Geared to Military Needs . . . Laboratory Instruments Continue Plentiful . . . Chief Features of Latest Industry Literature Are Outlined

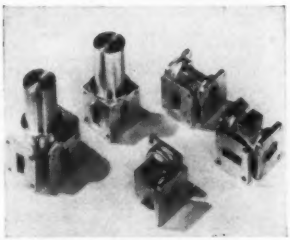
Ceramic Capacitor

SPEER CARBON CO., St. Marys, Pa., is now producing the J-cap, a thin disk ceramic capacitor of unusual physical strength, with dimensions of 0.156 in. maximum thickness and 0.594 in. maximum diameter. Now in mass production is the 0.005-μf 500-v unit. It will easily meet all requirements of the RTMA standards. Ratings are: minimum capacitance, 0.005μf; working volts, 500 v d-c; test voltage, 1,300 v d-c; leakage resistance, over 7,500 megohms; and power factor, less than 2.5 percent.



Subminiature Sliprings

NAER CORP., 631 S. Sepulveda Blvd., West Los Angeles 49, Calif., has developed a wide range of subminiature sliprings that are particularly advantageous where requirements demand mechanical and dielectric strength, insulation and arc resistance, absolute minimum torque friction, and a compact construction with silver, gold, or platinum rings securely molded in place. They are fabricated with Formex magnet wire which, because of the physical properties of its insulating film, plus its coating of NAER L-45 insulation, makes it extremely effective in all communications and industrial electronic equipment. The slip-rings are factory tested to 1,000 v and will fulfill all requirements for rigid standard operations.

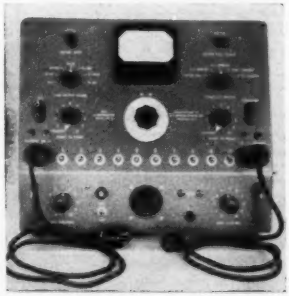


Microwave Components

GENERAL PRECISION LABORATORY, INC., 63 Bedford Road, Pleasantville, N.Y., has announced a line of specialized microwave components for use in radar, telecommunications, microwave experimentation and similar research or production fields. The lightweight, high-efficiency waveguide switch presents a maximum vswr of 1.10 in switched positions, and a vswr during switching interim of a maximum of 1.50. Cross attenuation varies from -25 to -40 db over a 10-percent bandwidth. The block switch complete with motor weighs only 6 oz. The twist-and-turn elbow provides both a bend and a modal rotation through 90 deg, in a unit no larger than a standard 90-deg bend alone.

Two-Way Radio Station

RADIO CORP. OF AMERICA, Camden, N.J. Model CSF-60A desk-type Fleetfone station combines a 60-watt transmitter-receiver and its power supply in a compact cabinet. The cabinet has ample room for mounting a line termination panel to permit remote operation of the transmitter. The equipment permits adjacent channel operation in the 30 to 50-mc band. The receiver has high selectivity, with nearly flat response over the desired modulation range of ±15 kc of the desired signal, and maximum rejection of undesired adjacent-channel signals.



Comparator

A. F. SMUCKLER & CO., INC., 202 Tillary St., Brooklyn 1, N.Y. The RXZ comparator is an instrument specifically designed to reduce the time consumed in the testing and inspection of completed complex electronic chassis, assemblies, sub-

READIN'-'RITIN'-'RITHMETIC

KNOW YOUR THREE Rs

when it comes to Tubes for Industrial, Military and Transportation service

RAYTHEON
RELIABLE
RUGGEDIZED

Type	Description	Controlled Characteristics: Shock	Fatigue vibration	Vibration output	Stabilization	Centrifugal acceleration	5,000 hour life	Heater cycle life	High temperature life	Median control	60,000 foot altitude	Proto-type	Heater Volts	Heater Ma.	Plate Volts	Plate Ma.	Grid Volts	Screen Volts	Screen Ma.	Amp. Fac-tor	Mut. Cond.
Reliable Miniatures																					
CK5654	RF Amplifier Pentode	√	√	√	√			√		√		6AK5	6.3	175	120	7.5	—2.0	120	2.5	—	5000
CK5686	AF-RF Output Pentode	√	√	√	√			√				—	6.3	350	250	27.0	—12.5	250	5.0	—	3100*
CK5725	RF Mixer Pentode	√	√	√	√			√		√		6AS6	6.3	175	120	5.2	—2.0	120	3.5	—	3200
CK5726	Dual Diode	√	√		√			√		√		6AL5	6.3	300	Max. Peak Inv. 330 volts. I_o=9 ma. dc per plate						
CK5749	RF Amplifier Pentode	√	√	√	√			√		√		6BA6	6.3	300	250	11.0	R_k=68 ohms	100	4.2	—	4400
CK5751	High Mu Dual Triode	√	√	√	√			√		√		12AX7	6.3/12.6	350/175	250	1.1	—3.0	—	—	70	1200
CK5814	Low Mu Dual Triode	√	√	√	√			√		√		12AU7	6.3/12.6	350/175	250	10.5	—8.5	—	—	17	2200
Reliable Subminiatures																					
†CK5702WA (6148)	RF Amplifier Pentode	√	√	√	√	√	√	√	√		√	5702	6.3	200	120	7.5	R_k=200 ohms	120	2.5	—	5000
†CK5703WA (6149)	High Frequency Triode	√	√	√	√	√	√	√	√		√	5703	6.3	200	120	9.0	R_k=200 ohms	—	—	25	5000
†CK5744WA (6151)	High Mu Triode	√	√	√	√	√	√	√	√		√	5744	6.3	200	250	4.0	R_k=500 ohms	—	—	70	4000
†CK5784WA (6150)	RF Mixer Pentode	√	√	√	√	√	√	√	√		√	5784	6.3	200	120	5.2	—2.0	120	3.5	—	3200
CK6110	Dual Diode	√	√	√	√	√	√	√	√		√	—	6.3	150	Max. Peak Inverse 420 volts. I_o=4.4 ma. per plate						
CK6111	Low Mu Dual Triode	√	√	√	√	√	√	√	√		√	—	6.3	300	100	8.5	R_k=220 ohms	—	—	20	4750
CK6112	High Mu Dual Triode	√	√	√	√	√	√	√	√		√	—	6.3	300	100	0.8	R_k=1500 ohms	—	—	70	1800
CK6152	Low Mu Triode	√	√	√	√	√	√	√	√		√	5975	6.3	200	200	12.5	R_k=680 ohms	—	—	15.8	4000
Rugged Miniatures																					
6AK5W	RF Amplifier Pentode	√	√	√				√				6AK5	6.3	175	120	7.5	—2.0	120	2.5	—	5000
6AL5W	Dual Diode	√	√					√				6AL5	6.3	300	Max. Peak Inv. 420 volts. I_o=9 ma. dc per plate						
6AS6W	RF Mixer Pentode	√	√	√				√				6AS6	6.3	175	120	5.2	—2.0	120	3.5	—	3200
6C4W	RF Power Triode	√	√	√				√				6C4	6.3	150	250	10.5	—8.5	—	—	17	2200
6J6W	Dual AF-RF Triode	√	√	√	√							6J6	6.3	450	100	8.5	R_k=50 ohms	—	—	38	5300
6X4W	Full Wave Rectifier	√	√					√				6X4	6.3	600	Max. Peak Inv. 1250 volts. I_o=70 ma. dc.						
Rugged GT Types																					
6J5WGT	General Purpose Triode	√	√	√								6J5GT	6.3	300	250	9	—8.0	—	—	20	2600
12J5WGT	General Purpose Triode	√	√	√								12J5GT	12.6	150	250	9	—8.0	—	—	20	2600
6SN7WGT	Dual Triode	√	√	√								6SN7GT	6.3	600	250	9	—8.0	—	—	20	2600
6X5WGT	Full Wave Rectifier	√	√									6X5GT	6.3	600	Max. Peak Inv. 1250 volts. I_o=70 ma. dc.						

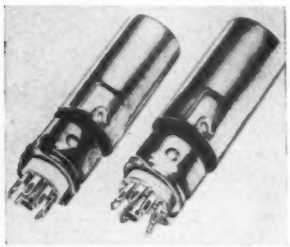
The above listing of Controlled Characteristics is based on the requirements and test limits of the applicable JAN-1A test specification.
Note: All dual section tube ratings are for each section. *2.7 watts Class A output. 10 watts Class C input power to 160 mc.
†For simplicity of identification with the prototypes, the type numbers with a "WA" suffix were established at the request of the Armed Services to replace the type numbers in parenthesis previously announced for these types.

Over 300 Raytheon distributors are at your service on these tubes. Application information is readily available at Newton, Chicago, Los Angeles.

RAYTHEON

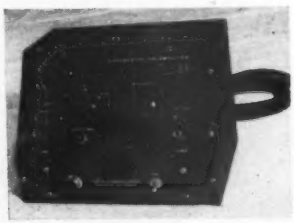
RAYTHEON MANUFACTURING COMPANY

assemblies and/or components, either resistive, reactive or complex combinations. The deviation in percent of the circuit under test as compared to the standard circuit is indicated on a calibrated dial. A switching system is incorporated by which abnormal deviations in a simple or complex circuit are pinpointed in the chassis under test. The instrument also incorporates means for specific trouble shooting by point-to-point impedance measurement and has an ohmmeter of wide range for individual component analysis.



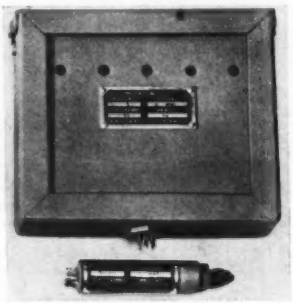
Military Tube Sockets

METHODE MFG. CORP., 2265 W. St. Paul Ave., Chicago 47, Ill., is now manufacturing military tube sockets featuring type MFE phenolic plastic insulators. Ceramic insulators are steatite, grade L-4B or better per JAN 1-10. Contacts are silver plated copper base alloy (phosphor bronze and beryllium where specified) with terminals hot tin dipped. Shields and bases on JAN S-28 units are steel cadmium plated; S-28A and Amendment 1 parts use brass, nickel plated.



Differential Preamplifier

OWEN LABORATORIES, 412 Woodward Blvd., Pasadena 10, Calif. The type 180 is an accessory amplifier for use with any laboratory oscilloscope in the investigation of low-level, low-frequency signals. It provides either single-ended or differential amplification. Output is single-ended only, and voltage gain is 50. Principal applications of the instrument are: (1) Increase of oscilloscope sensitivity; (2) Observation of difference voltages; and (3) Elimination of hum pickup. High-frequency response is flat to beyond 20 kc. In-phase signal attenuation is 1,000 to 1 or 60 db. Input impedance is 1 megohm at either input. Output impedance is less than 1,000 ohms. Power requirements are 115 v, 60 cps, 30 w.

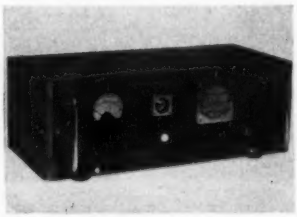


Pressure Gage

BYRON JACKSON CO., P.O. Box 2017, Terminal Annex, Los Angeles 54, Calif. Model PM-14 Vibrotron pressure gage is the first in a series of transducers developed to fill the need for a miniature electronic, pressure-sensitive pickup with variable frequency output. It is especially designed for use in aircraft and missile flight tests. The gage can be supplied in any pressure range from 0 to 3 psi absolute to 0 to 5,000 psi absolute. Output frequency range can be supplied in any bandwidth up to ±15 percent of the mean frequency. Minimum and maximum operating frequencies available are 1.5 kc and 12 kc respectively. It can be tuned to any of the RDB channels 6 through 12. Complete technical specifications for the gage and the oscillator illustrated below it are given in a recently issued bulletin available on request.

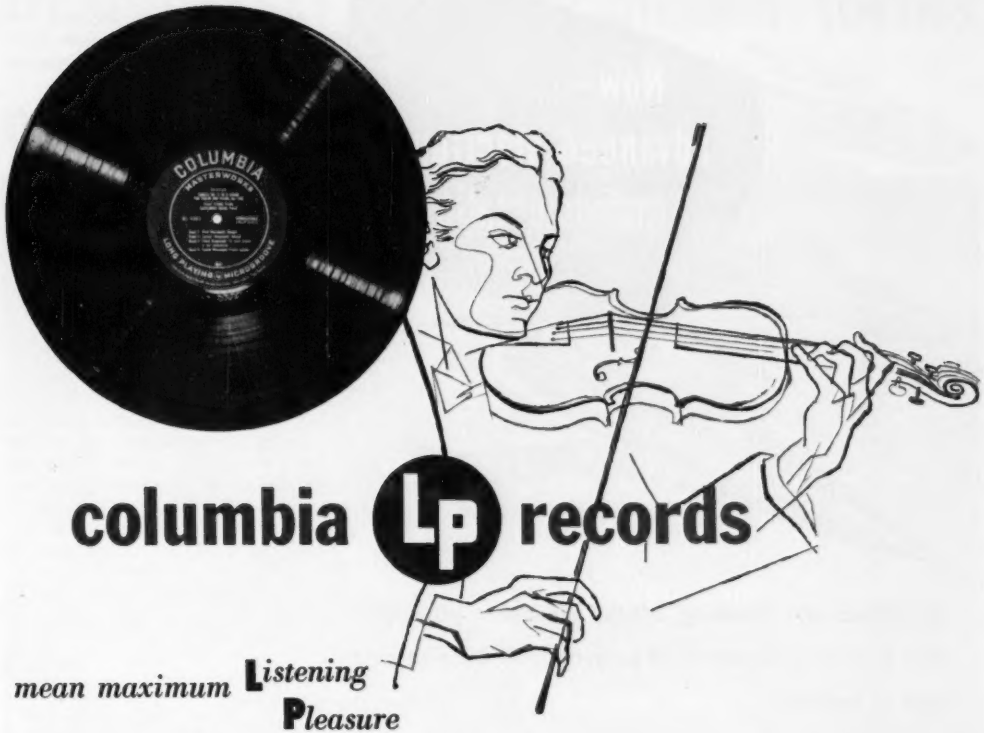
High-Peak Triode

RADIO CORP. OF AMERICA, Harrison, N.J. Model 5893 pencil-type triode tube is a medium-mu type capable of producing a peak output of more than 1,000 w in plate-pulsed service at frequencies up to 3,300 mc. Designed for pulsed-oscillator and power-amplifier service in the uhf region, it is engineered to provide h-f performance in both pulse and c-w applications. It is rated to take a plate-voltage pulse of up to 1,750 v on pulsed-oscillator service, and will maintain stable oscillations at pulse voltages as low as 800 v. In c-w applications it can deliver a useful power output of more than 6 w at a plate voltage of 300 v and a frequency of 1,000 mc. It measures 2⅞ in. in overall length.



Ionization Tester

AIRMEC LABORATORIES, LTD., 366 Madison Ave., New York 17, N.Y., has introduced a nondestructive and nonlethal equivalent of the insulation breakdown test. Threshold voltage at which ionization commences within an insulating material is indicated audibly and direct leakage currents are indicated visually, permitting continuous production testing or sampling without waste or danger. Type 732 5-kv unit covers



columbia LP records

mean maximum **L***istening* **P***leasure*

—thanks to the finest in modern sound recording methods and equipment

Music lovers everywhere know that Columbia LP records mean more listening pleasure—not in playing time alone, but in superb quality of reproduction. Yet few listeners outside the professional circle realize the degree of perfection which this record quality requires in every step of manufacture and processing. Take the original sound recordings and the processing masters, for example. Frequency response, signal-to-noise ratio, distortion and surface noise must measure up to standards which would have seemed entirely impractical a few years ago. But Columbia has found that Audiotape and Audiodiscs are an ideal combination for meeting all of these exacting requirements—Audiotape for recording the original sound and Audiodiscs for the masters from which stampers are made. In fact this same record-making combination is now being used with outstanding success by America's leading producers of fine phonograph records and broadcast transcriptions.

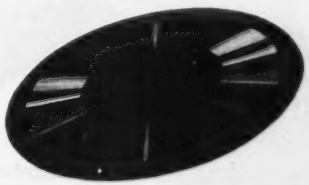
You can get this same sound perfection in *your* recording work, too—with Audiodiscs and Audiotape. Their superior quality is the result of more than 12 years of specialized experience by the only company in America devoted solely to the manufacture of fine sound recording media, both tape and discs.

®The exclusive trade-mark of Columbia Long Playing Records—symbol of highest quality. Trade-Marks "Columbia," "Masterworks," ®C. ® Reg. U.S. Pat. Off. Marcas Registradas.

AUDIO DEVICES, Inc.
444 MADISON AVE., NEW YORK 22, N. Y.
Export Dept.: 13 East 40th St., New York 16, N. Y. Cables "ARLAB"

...including
audiotape*
for the original sound

...and **audiodiscs***
for the master recording



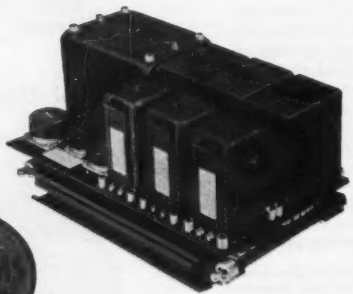
**Trade Mark*

...simplified by "building block" electronic packages makes possible synthesis of present and future aircraft control systems.

Servomechanisms, Inc., has pioneered in developing functionally-packaged standard plug-in units for electronic and electromechanical aircraft instrumentation. Servomechanisms technique of MECHATRONICS...the multiple and interchangeable use of standard units achieves simplified control systems which solve the aircraft need for:

- Instant Maintainability
- Training Simplicity
- Spatial Adaptability
- Ease of Assembly

A typical Servomechanisms, Inc. control system showing the multiple combination of building blocks, each block easily removable and replaceable...simple to check and service.



mecha

Fort Lauderdale, Fla. POST & STEWART AVENUES, WESTBURY, N.Y. El Segundo, Cal.

from 250 to 5,000 v; the type 755, a 20-kv tester, covers from 3,500 to 20,000 v. Both are continuously variable over the entire range.

Twin Power Triode

RADIO CORP. OF AMERICA, Harrison, N.J. The 6080 low-mu, high-perveance twin power triode is designed primarily for use as the regulator tube in stabilized d-c power-supply units. It employs a compact design in which special attention has been given to features that improve its strength against shock and vibration. Use is made of a button stem to strengthen the mount structure and to provide relatively wide interlead spacing for reduction in susceptibility to electrolysis. These features contribute to its dependability and suitability for use in military applications. It is also useful in projection tv scanning applications where pulsed plate voltages of high value are encountered.

Trespass Alarm

DONDAR DEVICES, P.O. Box 187, LaCanada, Calif., has introduced electronic devices that can be used to sound alarm bells or turn on lights, by merely approaching a sensitized area or by touching a sensitized object. Model 100 plugs into a 110-v a-c outlet. Price, including tubes, is $129.50. Model 101, the larger unit, will handle 1,000 w of flood lights without additional relays. Output terminals for 110 v and 8 v are provided on both the momentary circuit and the time-delay circuit, allowing wide flexibility in installation for bells, lights and additional relays. It plugs into

Designers! These standard forms of KEL-F* are now available...

Check these
✓Molded Sheets
✓Extruded Rod
✓Molded Rod
✓Extruded Tubing
✓Thin Film
* KEL-F is the registered trade name for polytrifluorchloroethylene — the high temperature fluorocarbon thermoplastic produced exclusively for commercial use by the Chemical Manufacturing Division of The M. W. Kellogg Company

Pre-Fabricated Kel-f Parts available in many standard sizes include

GASKETS ★ WASHERS ★ VALVE DISCS ★ "O" RINGS ★ "U" PACKING VALVE DIAPHRAGMS ★ PUMP DIAPHRAGMS ★ TRANSFORMER TERMINALS KEL-F COATED SILICONE-CORE "O" RINGS ★ ALSO KEL-F COATED HOOKUP WIRE

Molding Powders, both plasticized and unplasticized; *waxes; oils; greases;* and *dispersions* are available directly from the manufacturer.

KEL-F

Send for list of Kel-f molders, extruders, fabricators and coaters. Write

CHEMICAL MANUFACTURING DIVISION
THE M. W. KELLOGG COMPANY
A SUBSIDIARY OF PULLMAN INCORPORATED
P. O. BOX 469, JERSEY CITY 3, N. J.

WIRE *and* CABLE

for every application

The sensitive and dependable performance so important in electronic equipment demands wire and cable that conform to rigid specifications.

You can depend on Carol wires, cables, and wiring assemblies made to *your* specifications to *surpass* every test requirement!

Carol engineering and manufacturing facilities are complete—for we draw copper, copperweld, and aluminum; formulate our insulating materials from natural rubber or synthetic rubber or plastics. Carol is a complete wire mill with all the necessary adjuncts to be completely independent and without intermediate profits.

Constant Laboratory control over raw materials, work in process, and finished product assures dependable performance.

Check the advantages of Carol quality and service in solving your wiring problems. Write us about those problems *today!*

AMPERITE

THERMOSTATIC METAL TYPE

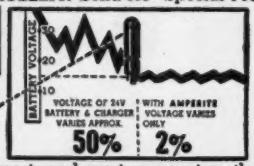
Delay Relays

PROVIDE DELAYS RANGING FROM 1 TO 120 SECONDS

FEATURES: — Compensated for ambient temperature changes from —40° to 110° F . . . Hermetically sealed; not affected by altitude, moisture or other climate changes . . . Explosion-proof . . . Octal radio base . . . Compact, light, rugged, inexpensive . . . Circuits available: SPST Normally Open; SPST Normally Closed.

PROBLEM? Send for *"Special Problem Sheet"*

Regulators



Amperite REGULATORS are the simplest, lightest, cheapest, and most compact method of obtaining current or voltage regulation . . . For currents of .060 to 6 Amps. . . . Hermetically sealed; not affected by altitude, ambient temperature, humidity.,

Write for 4-page Illustrated Bulletin.

AMPERITE CO., Inc., 561 Broadway, New York 12, N. Y.

In Canada: Atlas Radio Corp., Ltd., 560 King St., W. Toronto

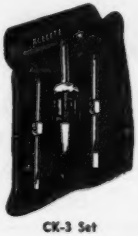
XCELITE *Hand Tools*

PREFERRED BY THE EXPERTS

XCELITE SCREWDRIVER

MONEY-SAVING TIPS ON BUYING SCREWDRIVERS and NUT DRIVERS

If your work calls for several different sizes of nut drivers, and Phillips and regular screwdrivers, buy detachable-handle *multiple sets*, rather than individual tools. The "99" set, for instance, is 13 tools for only $10.95. The CK-3 set gives you 6 screwdrivers and a 7/16" nut retainer handle for only $4.35!



CK-3 Set

XCELITE INCORPORATED

Formerly Park Metalware Co., Inc.

Dept. C Orchard Park, N. Y.

For Originality LOOK TO XCELITE

PLASTICON "P" Capacitors—

utilize polystyrene as the solid dielectric—especially suitable for these applications:

- computors • calculators
- saw-tooth oscillators
- RC circuits
- electronic controls
- integrating circuits

Plasticon Type "P" Capacitors have gained wide acceptance for a variety of applications in addition to those listed above.

Large values of capacitance are housed in CP 70 style containers. Soldered-in glass insulators assure hermetic sealing. Small values of capacitance are housed in our popular glassmike style containers.

OUR SPECIALTY is engineering capacitors to exacting requirements.

We invite your inquiries.

If you require the following characteristics, specify Plasticon "P" Capacitors:

Electrical characteristics at 25°C ambient temperature:

- high resistance 10^{11} ohms /mfd or 10^{11} ohms max.
- low power factor 0.05% or less
- low dielectric absorption 0.05%
- Q is practically constant from DC to 100 Kc

Other features:

- voltage ranges available 100, 400 and 1000V
- capacitance range 0.001 to 25 mfd
- capacitance tolerance 10% standard—also available 5%, 2% and 1%
- temperature range —60°C to +90°C
- temperature coefficient approx. 150 PPM/°C negative

MANUFACTURERS
Glassmike Capacitors
Plasticon Capacitors
HiVolt Power Supplies
Pulse Forming Networks

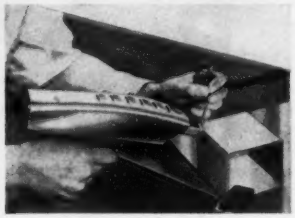
All Phones: **AMbassador 2-3727**

Condenser Products Company

7517 North Clark Street • Chicago 26, Illinois

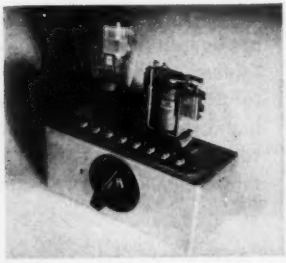
For
JAN-T-27
or
MIL-T-27
Requirements
Specify GTC Transformers
Our 23 years' experience in transformer manufacturing is your assurance of quality.
Our highly competent engineering staff and modern conveyorized assembly plant provide efficient design and prompt delivery of hermetically-sealed transformers.
We suggest that "GTC" is worthy of your consideration when you require transformers to meet military specifications.
PRIME and SUB-CONTRACTORS are invited to write.
Our new, self-contained plant, complete with metal-working and tool-making facilities, is available.
GTC
GENERAL TRANSFORMER COMPANY
serving industry since 1928
18240 Harwood Avenue, Homewood, Illinois
(Suburb of Chicago)

a standard 110-v a-c outlet. Price, including tubes, is $199.50.



Ultrasonic Soldering Iron

EAGLE ENGINEERING CO., 1139 So. Wabash Ave., Chicago 5, Ill. In the new technique developed by the Mullard Electronic Research Laboratories, the hard oxide skin is temporarily destroyed by passing ultrasonic energy through the molten solder. The equipment consists of a strong, portable power unit supplying either a soldering iron or a solder bath for dip tinning small components. There are no controls other than a main switch on the power unit and a trigger switch on the iron.



Electronic Timer

THE TIMETROL CO., P. O. Box 193, Rockford, Ill. Model 701 electronic timer incorporates unique circuit features that provide accuracies within 0.5 percent of time cycle. Time interval is continuously adjustable and accuracy is unaffected by supply voltage fluctuations. The timing cycle is initiated by a contact closure and a spdt relay is operated at the end of the timed interval. Time intervals from 0.05 to 20 seconds can be furnished. Spdt relay contacts are rated at 115 v, 5 amperes, noninductive. The unit operates on 105 or 130 v, 50 or 60 cycles, and it recycles instan-

Telemetering · Data Recording with AMPEX and Magnetic Tape!

- Telemetering
- Data Recording
- Shock Analysis
- Vibration Study

There's an AMPEX for the project.

Multi-channel recorder for seismograph data recording in the field with remote control. Custom construction by AMPEX.

Multi-channel continuous loop reproducer. Custom construction by AMPEX.

MODEL 303 is a system which records pulse width modulation on which the pulse width varies from 100 microseconds to 1,000 microseconds with a pulse width accuracy of ±2 microseconds at 30" per sec. The period of the pulse repetition rate must exceed the maximum pulse length by at least 75 microseconds.

MODEL 306 is designed to record low frequency data within the spectrum of 0 to 2,500 cycles ±1 db.

MODEL 307 is specially designed to record and reproduce all frequencies from 100 cycles to 100,000 cycles.

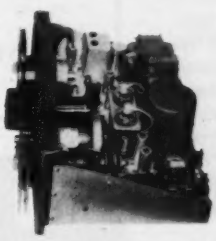
MODEL 375 is a 60 watt Capstan Motor-Power Amplifier driven by a precision, 60 cycle compensated tuning fork.

MODEL S3079 Air-borne recorder operates from 24 volt dc or 400 cycle aircraft supply; self-contained tuning fork frequency stabilizer; 2 speeds: 60" and 30"; same specs as for Model 307, except record only; can be modified for multi-track recording.

MODEL 500 Low Flutter and Wow of less than .1% peak to peak over the spectrum of 0 to 10,000 cycles is achieved by an exclusive-with-Ampex drive system. Complete specs and data describing this and all other special AMPEX equipment are available on request.

EXCLUSIVE IN CANADA: Canadian General Elec. Co., Ltd., 212 King Street, West, Toronto, Canada.

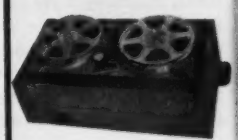
Visit Our I.R.E. Booth #485 and Military Exhibit



Model S3079 Air-borne recorder; a miniaturized Model 307

Low frequency data recorder. Custom construction by AMPEX.

Model 500 high stability multi-track recorder and playback



Mobile multi-channel shock and vibration data recorder. Custom construction by AMPEX.

For Immediate Details, Wire Or Telephone Collect: PLAZA 7-3091

Audio & Video
PRODUCTS CORP.
730 Fifth Avenue · New York 19, N. Y.

Cable Address: "AUDIOVIDEO"

Please send descriptive data on the following AMPEX models:

303...306...307...375...S3079...500...

My name is:.....

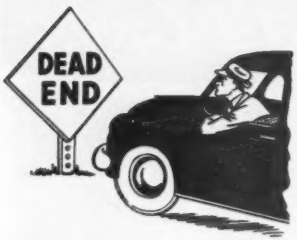
My business affiliation:.....

My position there:.....

Mail address:.....

City & State:.....

TRAINED MANPOWER IS SCARCE!



Is Your Trained Manpower Bogged Down in the Blind Alley of Routine Jobs?

Among your valuable assets, trained manpower ranks at the very top. Yet if your skilled technicians are tied down to routine testing jobs, you are not only wasting your assets, but you are fanning the spark of dissatisfaction.

All good men earnestly desire advancement. And you *can* advance them to more important responsibilities if you turn over your routine testing to a dependable, highly regarded commercial laboratory.

We can handle your routine testing. In many cases we can actually produce results more promptly than your own laboratories, especially if they are overloaded. Our staffs include engineers, chemists, physicists, biologists, and specially trained technicians. At their disposal is an extensive alignment of scientific equipment.

Let's discuss the matter at your convenience. We are sure we can show you a better way of handling your routine testing.

UNITED STATES TESTING COMPANY, Inc.

Established 1880
1550 Park Avenue, Hoboken, N. J.
PHILADELPHIA • BOSTON • PROVIDENCE
CHICAGO • NEW YORK • LOS ANGELES
MEMPHIS • DENVER • DALLAS
Member of American Council of Commercial Laboratories

FORD control motors . . .

for extremely low inertia and high frequency response

10 Watt

Rota
Inertia
0.23 oz-in.^{2}
Weight
4.3 lbs.

Write for Descriptive Brochure about all Ford Control Motors.

HIGH VOLTAGE MOTORS

60 Cycle, 1½-5-10 watt models
Designed specifically for electronic systems—operate directly in the plate circuit of a vacuum tube amplifier.

LOW VOLTAGE MOTORS

60 and 400 Cycle, 2½-5-10 watt models
Recommended for normal two-phase applications.

advantages

- Linear torque—voltage characteristics
- Linear torque—speed characteristics
- Withstand continuous stalling
- High torque efficiency
- Flexibility of mounting

FORD INSTRUMENT COMPANY
Division of The Sperry Corporation
31-10 Thomson Avenue, Long Island City 1, N. Y.

MU METAL SHIELDS

FOR MILITARY AND COMMERCIAL APPLICATIONS

Specializing in precision sheet metal fabrication, Multi-Metal produces components to exacting specifications.

Our engineering staff can help solve design and production problems. Your inquiries will receive prompt attention.

VISIT US AT BOOTHS 487-488 AT THE I.R.E. CONVENTION

Multi-Metal Co. 1350 Garrison Ave. New York 59, N. Y.

Every Top Management Man...In Every Industry

SHOULD BE ABLE TO ANSWER THESE QUESTIONS ABOUT A MOST CRITICAL EMERGENCY IN OUR COUNTRY'S AFFAIRS

Q. Why is iron and steel *scrap* a matter of importance to me?

A. Steel for our country's military program and civilian economy is being produced at the annual rate of 107,000,000 tons in 1951 . . . 119,500,000 tons expected in 1952. Steel-making capacity is being increased now to meet those quotas.

What Do I Get For My Scrap?

In addition to being paid for your scrap, you remove nuisance inventory from your plant—saving valuable floor space. Also, you have a better chance of *getting* new steel or steel products. But, *most important*—you help alleviate a dangerous condition threatening our country's capacity to rearm and satisfy civilian requirements at the same time.

Q. How does scrap figure in the production of steel?

A. Steel is composed, generally speaking, 50% of pig iron, 25% of "production" scrap (that is, the scrap which is produced as a by-product of steel-making) and 25% of "purchased" scrap.

Q. Is scrap getting scarce?

A. Yes. The supply of *purchased* scrap is not increasing fast enough to meet the needs of increasing steel production.

Q. What if the needed scrap isn't obtained?

A. Open-hearth furnaces will not be able to operate at capacity. That will mean a loss of steel production . . . and fewer products made of steel.

Q. Why not use pig iron instead of scrap?

A. Every ton of scrap conserves approximately 2 tons of iron ore, 1 ton of coal, nearly ¼ ton of limestone and many other vital natural resources—to say nothing of the extra transportation facilities that would be otherwise required.

Q. How can *more* scrap be furnished?

A. By everybody pitching in—as we always do in every emergency—and searching out all possible sources of scrap.

Q. What are these sources?

A. Metal-fabricating plants normally turn over to scrap dealers the scrap left from machining. But there's not enough of this to fill our present enormous need. So everybody—both in and out of the metal-fabricating industries—must sell scrap in the form of *idle metal.*

Every pound of idle metal is needed to keep our steel mills operating at top capacity. Sell your idle metal to a local scrap dealer right away.

What Do I Do *First*?

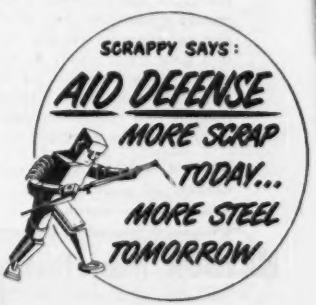
Write for free booklet. It tells how to set up a Scrap Salvage Program in your plant. Thousands of plants are cooperating. Do your part now! Address Advertising Council, 25 West 45th Street, New York 19, N. Y.

Q. *We* don't *produce* scrap—how can *we* help?

A. Scrap is any kind of iron and steel that's gathering dust—obsolete machines or structures, jigs and fixtures, pulleys and wheels, chains and track, valves and pipe—*anything* with rust on it or dust on it. Non-ferrous scrap is needed, too.

Q. What do we do with it when we find it?

A. Use your normal channels or get in touch with a recognized scrap dealer.

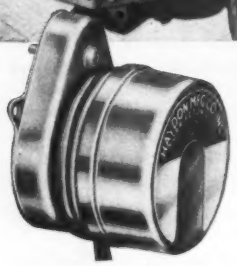


This advertisement is a contribution, in the national interest, by

McGRAW-HILL PUBLISHING COMPANY, INC.

330 WEST 42nd STREET **NEW YORK 18, N. Y.**

A PUBLIC SERVICE PROJECT · THE ADVERTISING COUNCIL ·



400 Cycle Motor

SYNCHRONOUS TIMING MOTORS and TIMERS for

- *Industrial*
- *Military*
- *Commercial Uses*

HAYDON* research and engineering staffs constantly seek to develop new and build better products. One example is the HAYDON 400 cycle timing motor. This is an hysteresis type synchronous timing motor, for use as a separate motor or in many different types of timers. HAYDON personnel and plant are equipped to build motors and timers using D.C., 60 cycle or 400 cycle for military or civilian applications.

HAYDON manufactures a wide range of dependable timing motors notable for their small size; quiet operation; total enclosure; separate systems for controlled lubrication of rotor and gear train; ability to operate in any position. Standard speed range from 60 rpm to one revolution in 7 days. The HAYDON motor is the basic element for standard timing components and custom-engineered timers designed and manufactured by the company for volume applications.

DESIGN INFORMATION

HAYDON will gladly send you technical data on request.

*TRADEMARK REG. U. S. PAT. OFFICE

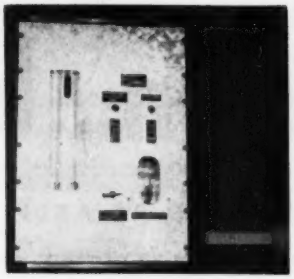
HAYDON Manufacturing Co., Inc.

Subsidiary of GENERAL TIME CORPORATION

2427 ELM STREET

TORRINGTON CONNECTICUT

taneously. It is 6 in. long, 3 in. wide and 6 in. high.



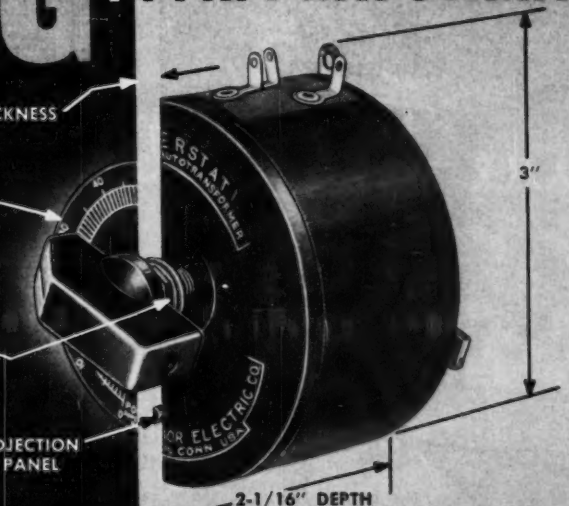
Microwave Calorimeters

TRANSPORT PRODUCTS CORP., Gillespie Field, Santee, Calif., has completed development and is in regular production on a line of primary standard microwave calorimeters. The single unit, weighing about 50 lb complete, operates throughout the microwave spectrum with any amount of power measurement from fractional watt to the maximum needed short of the breakdown point of waveguides.

Ignitron

RADIO CORP. OF AMERICA, Harrison, N.J., has announced the 5822 water-cooled, steel-jacketed, mercury-pool-cathode tube of the ignitron type for use in frequency-changer resistance-welding service. In the frequency-changer method of resistance welding, three-phase, 60-cycle power is converted to single-phase power having a frequency of about 5 to 12 cps. This method offers appreciable reduction in kva demand in comparison with that required in single-phase welding. The three-phase circuit balances the

SMALL . . . IN SIZE
BIG . . . in PERFORMANCE



TYPE 10 POWERSTAT
VARIABLE TRANSFORMER

RATED:

INPUT: 120 Volts, 60 Cycles
1 Phase

OUTPUT: 0 - 120/132 Volts,
1.25 Amperes
150/165 VA

APPLICATIONS

of POWERSTAT Type 10 are as innumerable as is the need for a variable a-c voltage control in today's low wattage electric and electronic equipment. It is ideal as the variable a-c voltage component in electronic tube testers; low wattage power supplies and rectifiers; low wattage heaters, furnaces, plastic molding equipment . . . and in any a-c voltage application where 50, 100 and 150 watt rheostats are now being employed.

A COMPACT VARIABLE A-C VOLTAGE CONTROL FOR LOW WATTAGE APPLICATIONS

To date, the many low wattage (50 . . . 100 . . . 150 watts) applications requiring variable a-c voltage control have had to be content with the inefficient, heat dissipating rheostats and other resistance types of control. With the introduction of the new POWERSTAT Type 10, the many advantages of POWERSTAT variable transformers are available for these low wattage requirements. A continuously adjustable output voltage from 0 to 120 or 132 volts is at the fingertips to control loads up to 165 VA. Type 10 does not have to be tailored to the load — it will deliver a variable voltage to any load up to its capacity. Type 10 is highly efficient — *does not* control by dissipating power in the wasteful form of heat. Other features: glass smooth commutator surface . . . advanced winding technique . . . superior core and coil design . . . rugged construction . . . single hole mounting . . . can be installed under a 3" chassis saving valuable space.

For additional information on the new, compact POWERSTAT Type 10, send for Bulletin P252.

Write to: 203 Thure Avenue, Bristol Connecticut

THE SUPERIOR ELECTRIC CO.
BRISTOL, CONNECTICUT

. . . and plan to see the new, compact POWERSTAT Type 10 at The Superior Electric display, booths 108, 110 at the I.R.E. Show, March 3-6

Sarkes Tarzian®

"Centre-Kooled"®

SELENIUM RECTIFIERS

★ JUST OFF THE PRESS!

Most complete book of its kind ever published . . . 80 pages of valuable information about Selenium Rectifiers . . . 48 pages of Radio & Television circuit diagrams . . . 20 pages on Power Rectifiers . . . 3 pages on High Voltage Rectifiers . . . a 7 page cross index replacement guide. Send 50¢ for your copy or see your distributor.

SARKES TARZIAN, INC. RADIO-TELEVISION BROADCASTING

Sarkes Tarzian, Inc.

RECTIFIER DIVISION

Dept. E-1, 415 North College Ave., Bloomington, Indiana

Just Published!

TELEVISION ENGINEERING

Second Edition

1. covers the whole television process—from studio to receiver—clearly, and in detail. Treats television technology, operating principles of TV systems, use of equipment. Provides practical working diagrams, complete with values of parts, tube types, etc. covers color TV, intercarrier sound reception, distributed amplification, and many other phases. **By Donald G. Fink, Editor, *Electronics*. Second ed., 721 pages, 512 illus., $8.50**

SHORT-WAVE RADIATION PHENOMENA

2. Thousands of facts, formulas, and numerical examples providing a thorough understanding of modern and classical wave-propagation concepts. Intensive treatment in 2 volumes explains and shows application of every frequency from those of about 30 megacycles per second to the highest radio frequencies in practical use. **By August Hund, Scientific & Tech. Radio Consultant. McGraw-Hill Radio Communication Series, 2 vols. (not sold separately) 1382 pages, 97 tables, 394 illus., $20.00 (available on terms.)**

GENERAL NETWORK ANALYSIS

3. A firm foundation for most phases of network analysis, including some of the background for network synthesis. Covers lumped and distributed networks in steady state and lumped networks in transient state—treats series and parallel circuits, magnetic coupling, simpler mathematical properties of generalized network response, Fourier and La Place integral, etc. **By Wilbur R. LePage, prof., and Samuel Seely, Prof. & Chairman—both of the Dept. of Electronic Eng., Syracuse U. 516 pages, 288 illus., $8.00**

AUTOMATIC FEEDBACK CONTROL

4. Gives information needed for the design and selection of automatic feedback control systems. Covers operation of controls and problems encountered in industry. Shows functional and constructional requirements of instruments. Covers servomechanisms, pneumatically operated controls, temperature regulation, speed governing, pressure flow, and liquid level. **By William H. Ahrendt, Pres. Ahrendt Instrument Co., and John F. Taplin, Consulting Eng., Kendall Controls Corp. 420 pages, 378 illus., $7.50**

10-DAY FREE TRIAL

McGraw-Hill Book Co., Inc.
330 West 42nd Street, NYC 36

Send me book(s) checked below for 10 days' examination on approval. In 10 days I will remit for book(s) I keep, plus few cents delivery, and return unwanted book(s) postpaid. (We pay delivery if you remit with this coupon—same return privilege.)

☐ 1. Fink—**TV ENGINEERING—$8.50**
☐ 2. Hund—**SHORT-WAVE RADIATION** — (2 vols.)—$20.00
Payable $5.00 in 10 da., $5.00 mo.
☐ 3. LePage & Seely—**NETWORK ANALYSIS—$8.00**
☐ 4. Ahrendt & Taplin—**AUTO FEEDBACK CON. —$7.50**

(Print)
Name .....
Address .....
City ..... Zone..... State.....
Company .....
Position L-3-52

This offer applies to U. S. only.

Now another

OF OUR PRECIOUS NATIONAL RESOURCES

IS WASTING AWAY

in your plant

It's iron and steel scrap.

Are you surprised to learn that scrap piles furnish just as much steel mill melting stock as iron mines do?

It's a fact. 50% of the melt is iron and steel scrap . . . and some of this scrap is wasting away in *your* plant.

This scrap of yours is needed to help maintain steel production so there will be enough steel for both military and civilian needs.

It's up to you to get idle iron and steel into the mills. Channel it through your local scrap dealer.

Don't delay. The mills need 3000 carloads of scrap a day—every pound counts in this emergency!

NON-FERROUS SCRAP IS NEEDED, TOO!

This advertisement is a contribution, in the national interest, by

McGRAW-HILL PUBLISHING COMPANY, INC.

330 WEST 42nd STREET, NEW YORK 18, N. Y.

This is about "Shock Mounts"

(Vibration Mounts for Airborne Equipment)

With 25% to 50% of the cost of a modern military airplane in electronic equipment, the once overlooked and often forgotten shock mounts have now come into a position of key importance. Their cost in relation to the equipment is insignificant; but their ability to protect valuable equipment should receive most careful evaluation by every design engineer. Only objective comparison will show the great difference in mounts. Most mounts are alike in general appearance.

Fundamentally, the fact that a mount complies with a given specification is the *beginning* of good design — not the end. Today, mounts which deliver more than the specification requirements; "plus" features — features of design and performance — pay off in maximum equipment protection through the widest range of operating conditions.

Robinson mounts basically have one important exclusive advantage: a superior load carrying cushioning element; MET-L-FLEX. This all-steel resilient material is *knitted* from stainless steel wire, compacted and compressed under an exclusive process. The elastic element thus formed is, in effect, a multiplicity of interlocked springs with built-in high damping, giving "Sea level performance at any altitude." This MET-L-FLEX cushion is then housed in a protective stainless steel spring, precision formed and with ground ends, which carries about 15% of the total load and holds the MET-L-FLEX in perfect alignment.

This exclusive design provides non-linear load deflection characteristics, and permits Robinson mounts to be overloaded or underloaded as much as 50% of their mean rated capacities.

Auxiliary MET-L-FLEX limiters, built into each mount, afford additional equipment protection against overloads due to combat maneuvers or landing impacts. The all-metal construction and the simple, rugged design provide three other important advantages: MET-L-FLEX mounts have a negligible drift rate; they are unaffected by extremes of temperature or other environmental conditions; and they are amazingly long-lived.

Weight comparisons are interesting, too! Robinson unit mounts, with their advanced design, weigh 50% less than some competitive mounts, yet have ultimate strength far exceeding specification requirements. *Another reason why you should compare before you specify!*

Leadership doesn't happen over night. Year after year Robinson has pioneered advanced designs for airborne applications. MET-L-FLEX unit mounts and mounting systems were the first successful all-metal airborne mounts, and Robinson has produced more all-metal mounts and mounting systems than all other manufacturers combined.

Production facilities have been expanded and have kept pace with increased demand.

Robinson know-how is yours in every MET-L-FLEX system. Robinson engineering and research are ready to help you solve your vibration control problems.

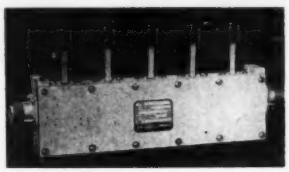
See us at the IRE Show — booth 53

ROBINSON AVIATION INC.
TETERBORO, NEW JERSEY
Vibration Control Engineers

power load and permits improved results in welding aluminum, magnesium and their alloys.

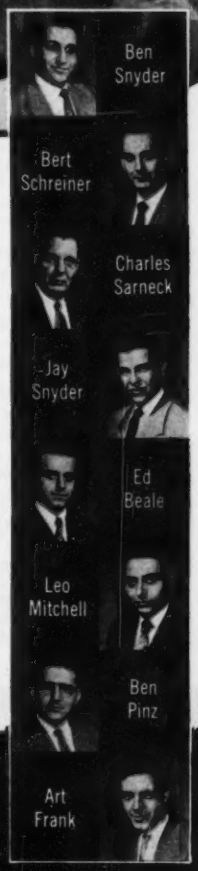
Electrostatic Tubes

GENERAL ELECTRIC CO., Syracuse, N.Y., has announced three additions to its zero-voltage electrostatic tube line. The 17VP4 is a 17-in. tube; the 20HP4-A/20LP4, a 20-in. tube; and the 21FP4-A, a 21-in. tube. All contain the electron gun that makes possible important savings of copper, nickel and cobalt through elimination of the focus coil. All are space-saving glass rectangulars. The 17-in. and 21-in. types have cylindrical faces.



R-F Attenuators

DAVEN CO., 191 Central Ave., Newark, N.J. With two units connected in series, the series RF-550 r-f attenuators are available with losses up to 100 db in one-db steps. The units have a zero insertion loss and have a frequency range from d-c to 225 mc. Standard impedances are 50 and 73 ohms. Resistor accuracy is within ±2 percent at d-c. An unbalanced circuit is used providing constant input and output impedance. Either the UG-58/U or UG-185/U receptacles are supplied with the units. Cable



They're all on *your* team—with just one purpose—to make your purchasing of Electronic Parts & Equipment QUICK, THRIFTY and ENJOYABLE!

Specialists all, they speak *your* language—know what you need and how to get it to you . . . in the shortest possible time.

Get to know them . . . they're *eager* to save you time and money!

HARRISON adds up to an experienced, conscientious staff . . . PLUS nine floors crammed with parts and equipment — *the one source for all your electronic needs!*

"HARRISON HAS IT"
JUST CALL
BArclay 7-7777
"Your *Winning* Number"

P.S.
What's YOUR E.I.Q.?
Find out at our Booth 323 in the I.R.E. Show. High scores win awards!

FREE 1200 PAGE CATALOG!
Purchasing Agents—Chief Engineers—Write on your company letterhead for your big, 1952 Buying Guide!

SINCE 1925 — ELECTRONIC PARTS AND EQUIPMENT DISTRIBUTORS

Cable Address — HARRISORAD

HARRISON RADIO CORPORATION

225 GREENWICH ST. (10 West Broadway)
NEW YORK 7, N. Y. • BArclay 7-7777

When you put the best available materials in your products you have no qualms about your reputation. That's why you will want to specify **DYNAPRENE** flexible cord . . . it is the best cord money can buy.

DYNAPRENE is long wearing and resistant to abrasion and the destructive effects of oils, greases, sunlight, alkalis and acids.

DYNAPRENE stands up longer under conditions that quickly destroy the usefulness of other types of cord.

DYNAPRENE flexible cords are jacketed with a specially developed Whitney Blake neoprene compound that is truly tough. These cords are made by the continuous vulcanizing process which assures accurate centering and uniformity of cure.

In **DYNAPRENE**, Whitney Blake has a quality product that will safeguard your reputation as well as theirs.

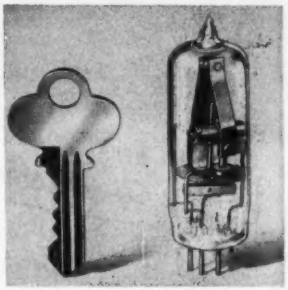
If you wish to test DYNAPRENE ask for a sample on your business stationery telling us the size and conductors required.

WELL BUILT WIRES SINCE 1899

WHITNEY BLAKE CO.

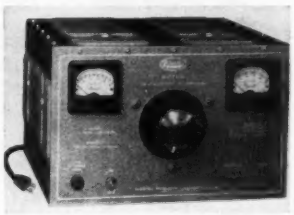
NEW HAVEN 14, CONNECTICUT

plugs can also be furnished if required.



Miniature Thermal Relay

THOMAS A. EDISON INC., Instrument Division, West Orange, N. J. Model 207 miniature thermal relay is designed especially for use in airborne electronic equipment. It is hermetically sealed in a T-5½ glass envelope with a miniature button 7-pin base. Weight is ½ oz, seated height 2½ in., diameter ¾ in. Delay periods are from 5 seconds to 120 seconds, standard heater voltages 6.3 v, 27.5 v and 115 v a-c or d-c. Contacts are rated at 2.5 amperes 125 v a-c, or 1.0 ampere 125 v d-c. It is ambient compensated from −60 to +85C.



D-C Power Supply

ELECTRO PRODUCTS LABORATORIES, INC., 4501 North Ravenswood Ave., Chicago 40, Ill. The new model N universal d-c power supply has an output range of 0 to 28 v at 15 amperes. An exclusive feature is the application of selenium rectifiers which increases the rectifier power rating and permits lower cost per ampere output. The unit supplies up to 36 v at 6 amperes. The a-c power is approximately 730 w with a 15-ampere 28 d-c volt load. The a-c hum or ripple at 15 amperes

For FAST, RELIABLE IMPEDANCE MEASUREMENTS

—It's the FTL-42A IMPEDOMETER

Measures Accurately Up to 500 Megacycles

An instrument of outstanding quality and efficiency . . . for research and development . . . rapid production testing and many other applications.

THE FTL-42A, a development of Federal Telecommunication Laboratories, Inc., is a simple, compact, easy-to-use instrument for the measurement of impedance, attenuation, reflection coefficient and standing-wave ratio at frequencies up to 500 megacycles.

Read relative voltages of incident wave, reflected wave and resultant . . . plot diagram of voltages on Smith Chart and impedance can be determined to ±5%.

The FTL-42A requires no unusual accessories —only those found in every laboratory and test shop working in the frequency range of the instrument: signal generator with 0.1 volt maximum output, crystal detector, audio amplifier, and output meter. Below 100 megacycles a radio receiver is desirable for its greatest sensitivity.

In addition, the FTL-42A Impedometer can be operated with input power up to several hundred watts when it is desired to drive the load in this manner.

Any signal generator with 0.1 volt maximum into 51.5 ohms output furnishes power for operation.

Crystal detector and audio amplifier with output meter have sufficient sensitivity as a detector above 100 megacycles.

Adapters for 1⅝-inch line to type N are furnished so that the instrument can be used with flexible cables. It can be used directly with 1⅝-inch line, or with other sizes of lines or cables by use of various adapters that are available.

Dimensions of cabinet are: 6¹³⁄₁₆ inches long by 5¾ inches wide by 5⅞ inches high. Net weight including adapters is 7 pounds. For complete information, write to Wire and Radio Transmission Systems Division for Brochure FTL-42A.

The FTL-42A Impedometer will be on display at "Federal Hall" (134-138) 1952 Radio Engineering Show, New York City, March 3-6

FEDERAL TELECOMMUNICATION LABORATORIES, Nutley, N. J. . . . . a unit of IT&T's world-wide research and engineering organization.

Federal Telephone and Radio Corporation

WIRE AND RADIO TRANSMISSION SYSTEMS DIVISION
100 KINGSLAND ROAD CLIFTON, NEW JERSEY
In Canada: Federal Electric Manufacturing Company, Ltd., Montreal, P. Q.
Export Distributors: International Standard Electric Corp., 67 Broad St., N. Y.

. . . We had stopped to watch the test run of a new Collins Helium Cryostat. As liquid helium poured into the dewar our guests, both electronic research workers, talked about Absolute Zero and Thermal Noise. As they talked we became interested . . . perhaps you will too.

. . . apparently they've based a recent research project on the theory that thermal motion ceases at absolute zero which might mean that a Signal-to-Noise Ratio at 0°K. would approach infinity. Using one of our Collins Helium Cryostats to get within 4° of absolute zero, they actually minimized thermal noise in circuit components.

. . . their guess was that perfection of this technique might conceivably lead to new control devices operating from minute energy changes . . . scintillation counters and voice modulation were mentioned as possibilities.

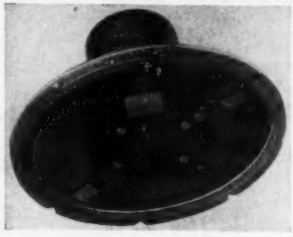
Perhaps your industry, equipped for low-temperature research, could profitably perfect a technique just like this.

Write for Bulletin E-1
on the Collins Helium Cryostat
and Low-Temperature Research in Electronics

ADL Mechanical Division

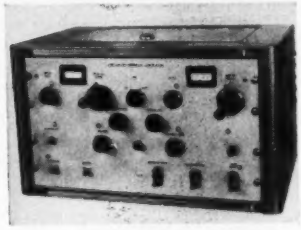
ARTHUR D. LITTLE, Inc.
Mechanical Division
30 MEMORIAL DRIVE • CAMBRIDGE, MASS.

is 8 percent, at 10 amperes 5 percent. New literature giving full details is available.



Coaxial Speaker

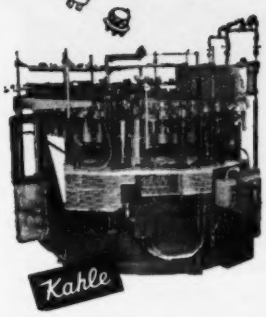
OXFORD ELECTRIC CORP., 3911 South Michigan Ave., Chicago 15, Ill., has announced model CO12JB, a 12-in. coaxial speaker, designed for quality a-m, f-m and tv receivers, as well as monitoring, recording applications and other sound installations. Frequency range is 65 to 15,000 cps; the network crossover at 4,000 cycles; power rating, 10 to 12 watts; input impedance, 8 ohms; size and magnet weight: woofer—12 in., 6.8 oz Alnico V; tweeter—3 in., 1.47 oz Alnico V.



UHF Sweep Generators

RADIO CORP. OF AMERICA, Harrison, N. J. Two new uhf sweep generators—the WR-40 A (with built-in markers) and WR-41A (without markers)—have been announced. They are of particular interest to research workers and engineers engaged in the developed of uhf tv receivers and other uhf equipment. Both feature continuous tuning from 470 to 890 mc and operation entirely on fundamental frequencies, with no beat notes or harmonics used. They have a continuously variable sweep width from 0 to 45 mc with an amplitude variation of 0.1 db per mc or less

Kahle equipment for manufacturing sub-miniature, miniature, power and cathode-ray tubes



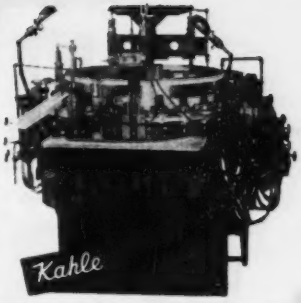
FOR MINIATURE TUBES

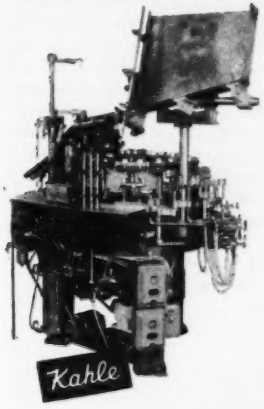
#1463
48-POSITION EXHAUST MACHINE

All degrees of operation from manual to completely automatic. Production limited only by pump equipment or loading speed of operator.

#1197
24-HEAD BUTTON STEM MACHINE

Two upper molds for making tubulated and non-tubulated stems. Dual motor drive. Cap. 1000 per hour. All automatic feeds.





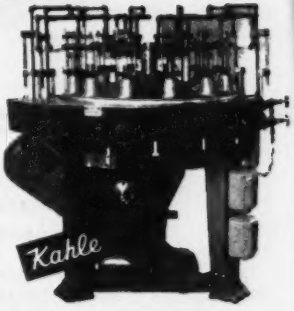
FOR SUB-MINIATURE TUBES

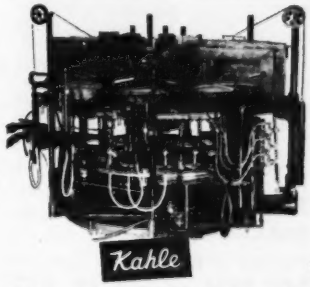
#1934
AUTOMATIC BULB MAKING MACHINE

Precise constriction and tubulation. Fully automatic including feeding and unloading. Cap. 2000 per hour. For flat, square, and round bulbs.

#1384
12-HEAD BUTTON STEM MACHINE

Upper and lower molds on every head. Dual motor drive. Indexing and head rotation are by separate motors. For oblong, square, round buttons, etc.





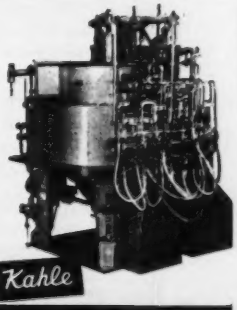
FOR CATHODE RAY TUBES

#1578
FACE PLATE SEALING MACHINE

Automatic; 8 heads. For sealing the glass face plates to the metal cones of metal cathode ray tubes—round or rectangular. Available also with 16 leads.

#1414
CATHODE RAY TUBE BUTTON STEM MACHINE

Production: 500 TV stems per hour. Fine adjustment of precision speed, pressure, heat, sequence of operations. Automatic transfer to conveyor annealer.



We welcome consultation. Write for our new catalog.

Kahle's 40 years of experience mean that standard toolings for all requirements *already* have been tested and approved. Machines for everything from sub-miniature to largest TV picture tubes designed and built to exact specifications . . . *at lower costs!*

KAHLE ENGINEERING CO.
1309 SEVENTH STREET • NORTH BERGEN, NEW JERSEY

National
PROVEN DEPENDABLE QUALITY
Components

7 and 9 PIN
MINIATURE
TUBE
MOUNTING ASSEMBLIES

National makes a complete line of mounting assemblies for all types of 7 and 9 pin miniature tubes. Of superior design, they are engineered to fit perfectly together and to make possible firmer, surer contacts and vibration-proof operation.

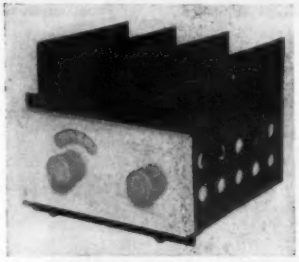
SOCKETS
SHIELDS
TUBE CLAMPS

National miniature sockets are of low-loss molded bakelite and provide for perfect mechanical installation and electrical contact. Shield base mounts in same holes as socket. Shield cap has spring in top and locks in place for firm support. Tube clamp also mounts in same holes as socket, holds tube firmly in place, yet is easily snapped on and off.

Write for drawings

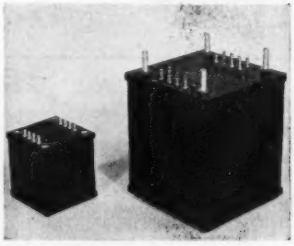
National
EST. 1914
NATIONAL COMPANY, Inc.
MALDEN, MASSACHUSETTS

throughout the swept range. Maximum output level of the sweep oscillator is 0.5 v across a 50-ohm load. Facilities are also provided for matching to either a 72 or 300-ohm load.



Airborne Receiver

GERTSCH PRODUCTS, INC., Los Angeles, Calif., is producing model AR-1 receiver, a five-tube miniaturized superhet broadcast receiver designed especially for airborne use where light weight, small size, high sensitivity and good signal-to-noise ratio are needed. Frequency range is 550 to 1,700 kc; sensitivity, better than 5 μv; i-f frequency, 456-kc; power required, 0.625 ampere at 2 v d-c, 0.050 ampere at 250 v d-c. Antenna input impedance is 72 ohms (coax line); audio output voltage, 0 db into a 600-ohm line, 1 mw reference; and weight is 2 lb, 4 oz.



Enclosed Transformers and Chokes

PLESSEY INTERNATIONAL LTD., Ilford, Essex, England, has introduced a range of new, totally enclosed, semisealed units, particularly suitable for use in industrial and test instruments and in communications equipment. These are

vacuum impregnated with bitumen varnish, and enclosed in one of five basic sizes of bitumen-filled cases. The electrical properties of the units may be varied in manufacture over a wide range to meet manufacturers' operational requirements. Maximum operating temperature of the transformers is 110 C.

Klystron Power Supply

POLARAD ELECTRONICS CORP., 100 Metropolitan Ave., Brooklyn 11, N.Y. Model KX is designed to power high power klystron tubes. This supply is an extremely stable low-ripple-content, h-v source. It provides either 300, 400, 1,000 or 1,250 v negative at high current with respect to ground. A 600-v supply at 18 ma is added on to the negative supply to provide repeller bias. Sufficient power is available to drive positive-grid-bias klystron tubes.

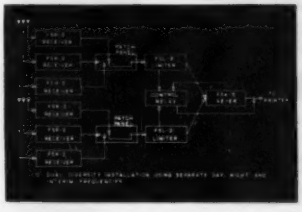
Monitor Kinescope

RADIO CORP. OF AMERICA, Harrison, N.J. The new, directly viewed, 7-in. c-r tube 7TP4 is intended for monitor service in connection with theater-tv systems, industrial tv equipment and portable broadcast equipment. It provides a 5¾-in. 4-in. picture. Utilizing electrostatic focusing, it features an electron gun of improved design to provide high resolution and good uniformity of focus over the entire picture area. Voltage can be maintained automatically with variation in line voltage and with adjustment of

National
Frequency Shift Receiving Equipment

the finest in automatic radio telegraphy

National Frequency Shift Receiving Equipment has been designed to incorporate all the latest advances in automatic radio telegraphy. It is used by the far-flung network of the Tropical Radio Telegraph Company, by agencies of this and other governments, and by shipping companies and news services. It is the finest, most dependable equipment yet designed for receiving radio signals and converting them into electrical impulses which in turn key automatic terminal equipment such as a teletype.



These basic units may be combined in a wide variety of ways to serve any purpose. Shown here is one typical installation.

FSR RECEIVER

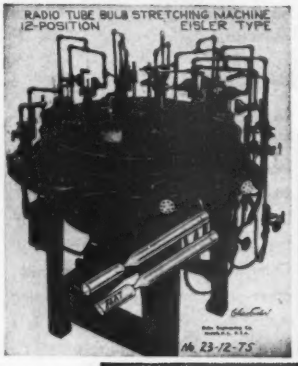
FSL LIMITER

FSK KEYER

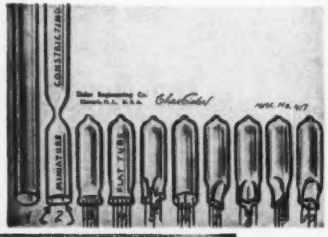
Write for complete descriptive folder

National
EST 1914
NATIONAL COMPANY, Inc.
MALDEN, MASSACHUSETTS
DEPT. BM-32

ELECTRONIC GLASS WORKING EQUIPMENT for RADIO, TELEVISION TUBES, INCANDESCENT LAMPS, GLASS LATHES for TELEVISION TUBE REPAIR. We make Transformers, Spot and Wire Butt Welders, Wire Cutting Machines and 500 other items, indispensable in your production. Eisler Engineers are constantly developing New Equipment. If you prefer your own designs, let us build them for you. Write to Charles Eisler who has served The Industry over 30 years.



Machines for small Radio Tubes of all kinds; 24-Head Stem, 24-Head Sealing and 24-Head Exhaust Machines, Spot Welders, etc.



EISLER ENGINEERING CO., Inc. 751 So. 13th St. Newark 3, N. J.

ENGRAVING and MARKING

The Green Engraver

ENGRAVES, ROUTS, PROFILES and MODELS

A real money saver for industry. Proven by the experience of tool and die, electronic machine, radio, electrical and instrument manufacturers.

The Green Engraver zips out precision work on metal, plastics, wood, glass, hard rubber, etc. . . . engraves panels, name plates, scales, dials, molds, lenses, instruments, instruction plates, directional signs . . . by simple tracing. Routing, profiling and three dimensional modeling indicate its versatility. Electronic etching attachment available.

Specify the Green Engraver for the best in low cost performance.

Special attachments and engineering service available for production work.

FREE — Fact-packed folder yours upon request.

Green Instrument Co.

363 Putnam Ave., Cambridge, Mass.

One Call for All!

JAN TYPE COMPONENTS!

- **WIRE** JAN-C-76
- **PAPER OIL CAPACITORS** JAN-C-25
- **TOGGLE SWITCHES** JAN-S-23
- **CONNECTORS** JAN-C-71
- **MICA WIRE LEAD CAPACITORS** JAN-C-5
- **SOCKETS** JAN-S-28A
- **CERAMIC CAPACITORS** JAN-C-20A
- **RESISTORS** JAN

Large Stocks of FULLY APPROVED **JAN** TYPE COMPONENTS *for Prompt Delivery!*

HUDSON
RADIO & TELEVISION CORP.
Formerly Newark Electric Co., Inc., of New York

48 West 48th St., New York 19, N. Y.
212 Fulton Street, New York 7, N. Y.
Phone: Circle 6-4060
Teletype: N. Y. 1-1299

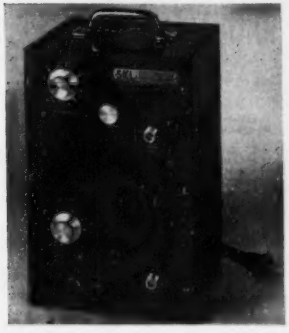
MISSILE
ENGINEERS and TECHNICIANS
for
FIELD TEST POSITIONS
in
NEW MEXICO
"The Land of Enchantment"
★ ★ ★ ★
ON
Guidance
Flight Testing
Servomechanisms
Telemetering
Test Equipment
Airborne Electronics Equipment
★
IDEAL WORKING CONDITIONS
WRITE: FIELD TEST DIRECTOR
P. O. BOX 391
HOLLOMAN AIR FORCE BASE
NEW MEXICO

BELL Aircraft CORPORATION

picture brightness. It also features a metal-backed fluorescent screen that eliminates the need for an ion-trap magnet.

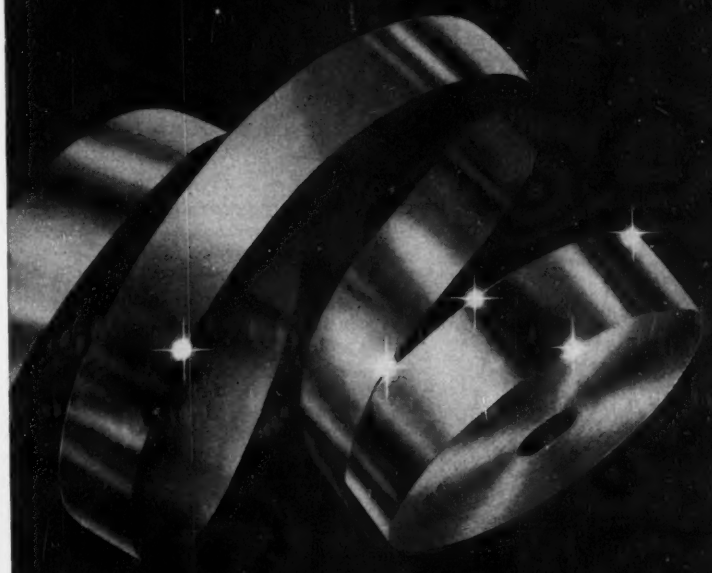
Five-Inch Oscilloscope

TELEVISION EQUIPMENT CORP., 238 William St., New York 38, N. Y. Model T-601B five-in. oscilloscope provides Y-axis response within 3 db from 2 cycles to 12 mc at 10 mv rms per inch deflection sensitivity. The sweep generator provides either recurrent sweeps from 10 cycles to 100 kc or triggered sweeps from 5 μsec to 10^5 μsec. Phasing is provided for 60 cycle sweeps and all sweeps may be synchronized to either positive or negative peaks. Features include front panel availability of sweep sawtooth and retrace pulses for convenience in synchronizing, sweeping or blanking external circuits with the scope.



Fast-Rise Pulse Generator

SPENCER-KENNEDY LABORATORIES, INC., 186 Massachusetts Ave., Cambridge 39, Mass., has announced model 503 fast-rise pulse generator that produces a rectangular pulse having a rise time less than 10^{-8} seconds. The width of the pulse is controlled by the external width cable and may be as short as 2×10^{-8} seconds. Pulse amplitudes from 0.1 to 100 v, of either polarity, may be selected. A single pulse, controlled by an external trigger, or internally controlled repetitive pulses, with repetition rates from 50 to 150 per second, may be produced. The unit is designed for testing the transient response of

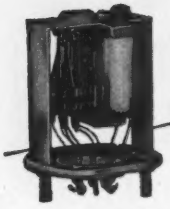


INCREASE PRODUCTION
WITH
REPUBLIC
ALUMINUM FOIL

Republic Capacitor Foil is the first choice of manufacturers because its consistently accurate gauge, clean, straight edges, and uniform high quality, permit maximum production and economy through a minimum of down-time and rejected sections.

Republic Capacitor Foil is available in widths of ¼" and wider, and in gauges from .00017" to .005".

REPUBLIC FOIL & METAL MILLS
INCORPORATED
Sales Offices: 209 W. Jackson Blvd., Chicago 6, Ill.
666 Mission St., San Francisco 5, Cal.
DANBURY CONNECTICUT



SIGNAL ENGINEERING SERIES 80

MIDGET TELEPHONE TYPE RELAYS...

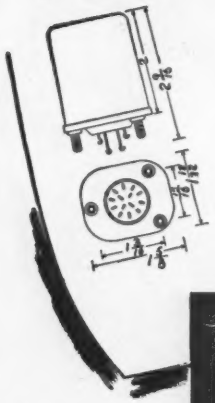
Compact, multiple contact with vibration and shock-proof characteristics. Designed to meet various operating requirements typical of Armed Services applications.

Unique pile-up arrangement reduces width below the conventional relay, thereby reducing over-all space volume.

Available with octal base, sealed or unsealed, and snap-on dust covers, and also hermetically sealed containers. Also equipped with modified type AN 3106-20-27P sealed connector.

Write for Bulletin MTR-6

Sales Representatives in Principal Cities



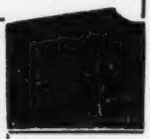
Wheelock RELAYS

SIGNAL ENGINEERING & MFG. CO.

154 WEST 14TH ST. NEW YORK 11, N.Y.

NOW AVAILABLE ON EASY TERMS

Save trouble, time, and money with the aid of this practical RADIO ENGINEERING help . . .



Presents RADIO PRINCIPLES, STANDARDS, and PRACTICES for the designer, engineer, and radio technician

HERE is a handy volume embracing a great deal of constantly needed reference material covering all fields and aspects of radio engineering — concise, dependable, arranged in easy-to-get-at form.

What the Standard Handbook, Marks' Handbook, and others are in their respective fields, Henney's Handbook is in the radio field . . .

And now this new Fourth Edition is available:

with new data on the physical, mathematical, psychological, and acoustical bases on which all electrical communication exists . . . on the means of transmitting and utilizing energy in the very high frequency portions of the radio spectrum.

with completely rewritten sections on radio communication, inductance, radio-frequency amplifiers, modulation and detection, electron tubes, receiving systems, radio aids to aviation, and many other subjects.

with revision throughout to make the book as useful as possible in modern practice.

New 4th Edition

RADIO ENGINEERING HANDBOOK

Keith Henney, Editor-in-Chief
Consulting Editor of Electronics
1197 pages, 6 x 9, 1038 illustrations, $10

IN scope, this book ranges from fundamentals to discussion of newest circuits, amplifiers, power supply systems, short-wave systems, etc. Frequency modulation, developments in television and aircraft radio, and other applications are covered. The book abounds in circuit diagrams, tables, charts, formulas, design equations and data. The circuits described quantitatively are those in use today, or soon to be widely used.

In RADIO ENGINEERING HANDBOOK you get—

1. 1197 pages of carefully selected, accurate data—charts, tables, circuits, diagrams, formulas.
2. 23 sections covering all the most needed subjects for engineers and radio technicians, from fundamentals to specialized applications.
3. Every section prepared by one or more specialists, to assure you dependable, expert answers to your problems in design and practice.

Not only the radio technician, but every man interested in the design or manufacture of radio or television transmitters and receivers and apparatus utilizing vacuum tubes and photocells, will find this improved handbook a helpful, day-to-day guide.

SPECIAL OFFER

When you receive a copy of Henney's RADIO ENGINEERING HANDBOOK you can look over the book for 10 days before deciding whether or not to buy it. Then, if you decide to keep the book, you can pay for it in easy monthly terms—$4.00 at the end of 10 days, and $3.00 per month until balance is paid.

McGRAW-HILL

SEE THIS BOOK 10 DAYS FREE

McGraw-Hill Book Co., Inc.
330 W. 42nd St., New York 18

Send me Henney's RADIO ENGINEERING HANDBOOK for 10 days' examination on approval. If I find the book satisfactory, I will send you $4.00 in 10 days, plus a few cents for delivery, and $3.00 a month until $10.00 has been paid. Otherwise I will return the book postpaid.

Name .....

Address .....

City ..... Zone ..... State .....

Company .....

Position FL-3-52

This offer applies to U. S. only.

IT'S YOUR LOGICAL CHOICE

Burlington

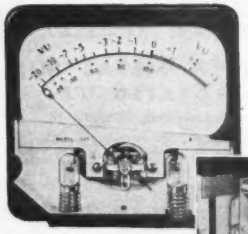
ILLUMINATED INSTRUMENTS

EXCELLENT LIGHT DISTRIBUTION affords EASE IN READING. GLARE REDUCED to a minimum by retaining COMPACT DESIGN of front case extension.

REFLECTED LIGHT PRINCIPLE permits use of standard METAL DIALS eliminating translucent materials that discolor with age and use.

BULB REPLACEMENT FACILITATED by removal of single lamp assembly.

Two 3.8 volt STANDARD BULBS are used and connected in series.



Available in all ranges 3½" and 4½" rectangular semi-flush models

Cutaway views showing positions and connections of lamp assembly.

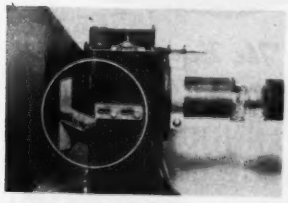
Write Dept. F-32 for complete details.

BURLINGTON INSTRUMENT COMPANY
BURLINGTON, IOWA

wide-band systems, but can also be used for the generation of impulse or continuous spectrum noise for signal-to-noise ratio testing and for narrow-band receiver alignment.

Tubular Ceramic Capacitors

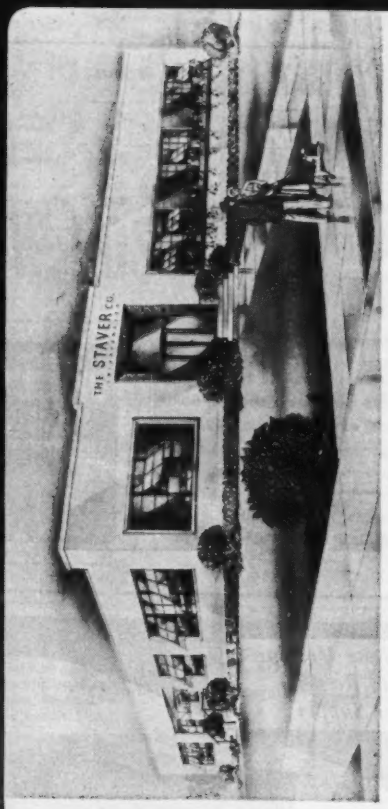
AEROVOX CORP., New Bedford, Mass. Type SI-TV high-voltage tubular ceramic capacitors are of the Hi-Q brand manufactured by the Electrical Reactance Corp., an Aerovox subsidiary, for distribution to and through the latter's jobbers to the service and experimenter trade. These ceramics are available in a 6,000-volt rating and in eleven capacitance values from 4.7 to 47 $\mu\mu$f.



Pin-Cushion Corrector

ALL-STAR PRODUCTS, INC., Defiance, Ohio. The PK-1 two-piece pin-cushion corrector set is designed to eliminate tv image distortion in the corners of the picture tube caused by errors in the deflection fields and in the picture tube geometry either separately or in combination. It consists of a small piece of Alnico V magnet material with correctly designed pole pieces. There are two units in the set for mounting on the deflection yoke mounting bracket on each side of the picture tube. Control of the amount of correc-

GREATER PRODUCTION . . . Quicker Deliveries



STAVER'S NEW HOME

This modern structure houses a large manufacturing area, tool room, experimental laboratory, office space, and shipping and receiving department.

WITH a threefold expansion in manufacturing facilities, the Staver Company is now in a better position than ever to design, produce and deliver our standard line of tube shields, tube holders and precision electronic stampings — plus a new line of electro-mechanical switching devices for the aircraft, communications and electronic industries.

Our engineering department is available now, to discuss your requirements. Complete information on our facilities and capacity is yours for the asking. Phone Bay Shore 3620 or write . . .

THE STAVER COMPANY, INC. 41-51 North Saxon Ave. Bay Shore, L. I.

JELLIFF RESISTANCE WIRES

ARE VERY MUCH AT HOME IN A HOT • SPOT

ALLOY	OHMS PER CMF	MAX. OPER. TEMP.	WIRE DIA. RANGE	FORMS†	USES
1000	1000	500° F	0.0056 0.0009	W-R	Compact, stable precision Resistors
ALLOY C	675	1700° F	0.2890 0.0008	W-R	Appliances and Resistors
ALLOY A	650	2100° F	0.0410 0.0010	W-R	High-temp. Furnaces and Resistors
ALLOY 45	294	930° F	0.2890 0.0010	W-R	Precision Applications

†W—wire R—ribbon

★

Whether the heat is literal (up to 2100 F), or figurative in the sense that performance under difficult conditions is a *must*, we have an alloy for almost any conceivable requirement. The above Table may suggest possible applications to your products.

★

Complete Technical Data are available from Department 17.

THE C. O. JELLIFF MANUFACTURING CORPORATION SOUTHPORT, CONN.

1907

AIRDESIGN

Quality — Specialty

TRANSFORMERS

For years we have supplied leaders of the Electronic and Electrical industries with superior specialty transformers.

↓

Let us quote on your special commercial and military requirements.

↓

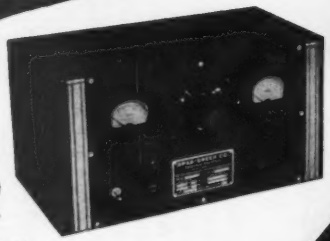
A reliable source since 1941

↓

Write us today—or telephone Granite-4-8000

AIRDESIGN, INC.
241 Fairfield Avenue
Upper Darby 2, Pa.

NEW! *Low Voltage Selenium Rectifier Power Supply*



IN STOCK!

MODEL GPA2810

Input: 115 VAC 60 cy. Single Phase

Output: 0-28 VDC 10 Amperes. continuous duty.

A reliable source of unfiltered direct current for laboratory and production testing.

$115.00 Net F.O.B. our N.Y.C. Factory.

Special Selenium Rectifier power supplies available to specifications. Write for Rectifier Equipment Questionnaire. Proposals and recommendations forwarded promptly.

Opad-Green COMPANY
71-2 Warren St., New York 7, N. Y.
Phone: REekman 3-7385-6

HERE'S BIG HELP IN TERMINAL WIRING!

The New **JONES FANNING STRIP**

The correct wire to correct terminal every time!

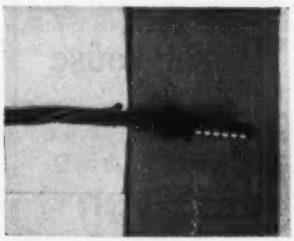
Connections are made through Fanning Strip, on bench or anywhere apart from barrier strip, and quickly slipped into assembly.

Use with Jones Barrier Terminal Strips, Nos. 141 and 142, for 1 to 20 terminals.

Simplifies soldering. Insures correct connections. Saves time. Ideal for harness or cable assembly. Brass terminals, cadmium plated. Bakelite mounting. Send for complete data.

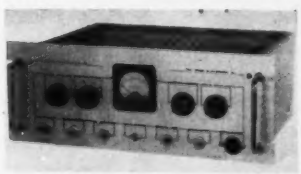
Jones — HOWARD B. JONES DIVISION CINCH MANUFACTURING CORPORATION

tion is obtained by moving the PK-1 toward the face or base of the tube. The PK-1 achieves correction by providing a magnetic field with the same curvature and strength as the error component of the deflection field but in the opposite direction.



Slipring Assemblies

AIRFLYTE ELECTRONICS CO., 21 Cottage St., Bayonne, N.J., offers slipring assemblies ranging from 0.025 in. to 3 in. in diameter with from one to 35 contact rings of silver, gold, platinum or alloys thereof. These units are either molded, plated plastic or stacked, and are finished to a 4-microinch surface with concentricities as low as 0.0005-in. total indicated runout. Voltage breakdown of 50 v per mil of external ring spacing can be held. Picture shows slipring assembly with ring diameter of 0.080 in. and hub of 0.093 in.



Direct-Coupled Amplifier

THE BRUSH DEVELOPMENT CO., 3405 Perkins Ave., Cleveland 14, Ohio. Model BL-962 direct-coupled amplifier, designed for use in standard 19-in. rack and having a 7-in. high front panel, was meant to be used with magnetic direct-writing oscillographs in studies of such static or dynamic conditions as strains, displacements, pressures, light intensities, temperatures and a-c or d-c voltages or currents. Volt-

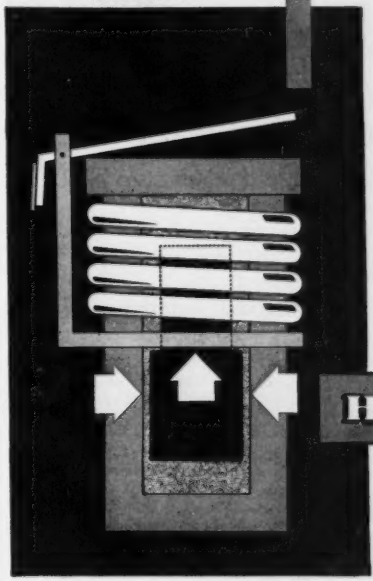
Silic-O-Netic TIME DELAY RELAYS

LOW COST and DEPENDABLE

Better performance in a time delay relay for your products need not run your costs UP. The basic design of the new SILIC-O-NETIC Time Delay Relay lends itself to Heinemann high production techniques . . . creates savings that are passed on to you as LOWER unit costs.

SILIC-O-NETIC Relays provide other savings, too. As a load carrier in itself, it eliminates the need for a separate load relay. Being small in size, it reduces the overall size requirements of equipment with which it is used. SILIC-O-NETIC Time Delay Relays have only one moving part in the time element, which is hermetically sealed . . . and never requires attention.

Complete information is available upon request. Write for Bulletin 5001.



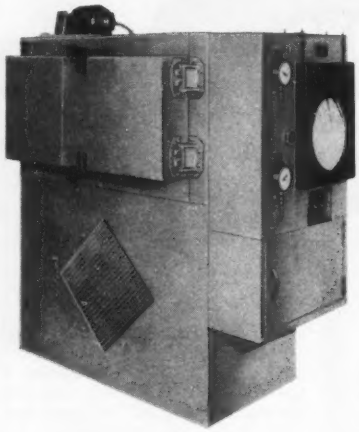
The SILIC-O-NETIC Time Delay Relay employs silicones . . . operates dependably on a hydraulic-magnetic operating principle regardless of position or frequency of operation. Overall size is only 1⅛" x 2½" x ¾".

HEINEMANN

ELECTRIC COMPANY

97 Plum Street, Trenton 2, N. J.

TEST CHAMBERS



HIGH & LOW TEMPERATURES

CONTROLLED HUMIDITY

- −150°F. to +200°F.
- 20% to 95% R.H.
- 1 cu. ft. to 75 cu. ft. cabinets

Walk-in Rooms
Temperature Baths

Electronic or pneumatic recording or indicating control systems

CUSTOM CHAMBERS built to specifications.

Years of satisfactory service!

Standard CABINET COMPANY

56 Washington Avenue
Carlstadt, New Jersey

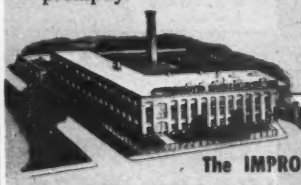
Use "IMPROVED" Silver-facing for speed, quality, durability!

We are equipped to render rapid, dependable service in brazing silver to your pre-shaped contact parts.

Consult us also for any problem concerning wire, sheet or tubing where a composite material, i.e. silver-copper, gold-nickel, copper-iron, etc., is desired.

Your inquiries will be appreciated and replied to promptly.

We invite you to send for a free copy of our brochure, "The Story of Laminated Metals."



The Home of IMPROVED Service

The IMPROVED SEAMLESS WIRE COMPANY
INCORPORATED 1906

Dept. 1-A 775 Eddy Street, Providence 5, Rhode Island

- **ELECTRONIC DESIGN ENGINEERS**
- **TECHNICAL WRITERS**
- **DESIGN DRAFTSMEN**
- **PHYSICISTS**

Westinghouse

offers you

SECURITY AND OPPORTUNITY

EE's and ME's with over 3 years experience . . . a number of excellent positions are now available in our Electronic & X-ray and Air-Arm Divisions for work on:

- Broadcast Transmitters
- Power Line Carrier Communication Equipment
- Railroad Radio
- Radio Frequency Heating
- Medical and Industrial X-ray
- Commercial Radar
- Balancing Equipment
- Military Radar (ship, ground, airborne)
- Military Transmitters
- Specialized Electronic Equipment
- Fire Control Systems
- Automatic Pilots
- Guided Missiles

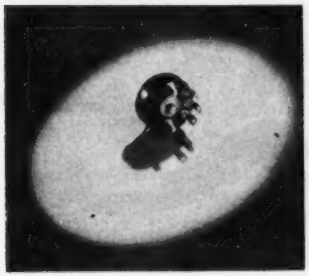
Check These Outstanding Benefits: Top pay, ideal working conditions, advancement on merit, graduate study opportunities, employee scholarships, paid relocation expenses, Baltimore location.

Send resume of experience and education to: Manager of Industrial Relations, Westinghouse Electric Corp., 2519 Wilkens Ave., Baltimore 3, Md.

If you are using your greatest skill in a defense industry, do not apply.

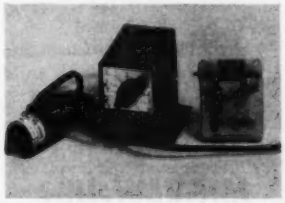
YOU CAN BE SURE...IF IT'S
Westinghouse

age gain of the instrument is sufficient to give 1 mm of deflection on the oscillograph chart per mv input. When the amplifier is used with the penmotor, the frequency response is essentially linear from d-c to 100 cps. The control panel on the face of the unit contains an attenuator with five factor-of-ten positions, gain control, calibrating meter and controls for determining input voltages.



Radiohm Control

CENTRALAB DIV. OF GLOBE-UNION, INC., 900 E. Keefe Ave., Milwaukee 1, Wis., announces production of the high-torque model I Radiohm control, designed specifically for maintenance of circuit balance under conditions of vibration. This unit is intended especially for equipment used in commercial or government installations where miniature size also is a prime requisite. The unit's torque range is from 2 to 4 oz-in.



Motor Control System

SERVO-TEK PRODUCTS CO., Paterson, N. J., has added to its line a tiny motor speed control system with a companion line of motors. It measures 3 in. × 3 in. × 2 in. The companion motor measures 1¼ in. in diameter × 1½ in. long. The electronic control unit for unidirec-

FEDERATED

your source for RCA industrial tubes

Federated Purchaser, Inc. maintains one of the nation's leading distributor inventories of RCA Industrial Tubes for prompt shipment.

RCA-6146 New Beam Power Tube For VHF Transmitters

RCA tubes for industry

VACUUM POWER PHOTOTUBES
THYRATRONS OSCILLOGRAPH TUBES
VACUUM & GAS RECT. CAMERA TUBES
IGNITRONS MONOSCOPES
COLD-CATHODE SPECIAL TYPES

One Source for Your Electronics Supplies

Innumerable in stock JAN parts and thousands of other Electronic Materials available for Industrial Electronics users. Strategic locations in key industrial areas makes possible prompt shipment to any part of the country. You purchase economically, reduce warehousing and depreciation costs.

Take advantage of our complete stocks, our unique service —Make Federated your one source of supply!

Free—RCA Interchangeability Directory
Handy Guide to selection of proper RCA tube type replacements. 1600 Tube types listed.
Write Dept. E-3

CABLE FEDERPURCH
Federated Purchaser
INCORPORATED
INDUSTRIAL ELECTRONICS DISTRIBUTORS

New York City 66 Dey St. Digby 9-3050
Newark, N. J. 114 Hudson St. Market 3-9035
Allentown, Pa. 1115 Hamilton St. Phone 3-7441
Easton, Pa. 925 Northampton St. Phone 4259

TELETYPE: NY1-2859 (New York, N. Y.) • AN-22 (Allentown, Pa.)

Men Who Use Them Know...

WILTON

IS THE FINEST NAME IN VISES

Write for 32 page catalog of Vises, Work Positioners and Industrial Clamps.

Sold Only Thru Distributors

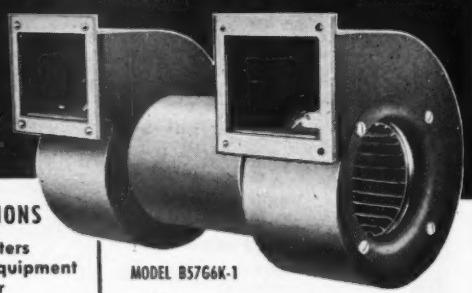
WILTON TOOL MFG. CO.
925T WRIGHTWOOD AVE.
CHICAGO 14, ILL.

3

Special CENTRIFUGAL BLOWERS

for Maximum CFM • High Shock • Critical Mounting

Designed at low cost to meet your specifications. Standard units also available.



MODEL B57G6K-1

APPLICATIONS

- Transmitters
- Radar Equipment
- Amplifier Equipment
- High Ambient Temperatures
- High Humidity Applications

SPECIFICATIONS

MODEL B57G6K-1: 115 volt AC • 60 cycle • single phase • 4 mfd. • 120 CFM at 0.5" SP—220 CFM at 0" SP • Silicon impregnated • Fungus proof.

EAD

EASTERN AIR DEVICES, INC.

585 DEAN STREET • BROOKLYN 17, NEW YORK

"HOLY MOSES... there's something I never knew before!"

F-11A

Unless you're exceptionally well-informed there are probably lots of things YOU never knew before right here in the advertising pages of this magazine.
Alert manufacturers use these advertising pages to get the *news* about their products and services to you . . . quickly and effectively.
Their advertisements contain information designed to help *you* do your job better, quicker and cheaper.
To be well-informed about the latest developments in *your* industry . . . and to stay well-informed . . . *read all the ads too.*

McGRAW-HILL PUBLICATIONS

tional operation over an approximate 40 to 1 speed range contains the special electronic circuits, tube and speed control potentiometer. Motor horsepower is approximately 1/250 hp; motor-shaft speed, from 10,000 rpm to 250 rpm. A signal is used in a feedback circuit to counteract speed decrease as a function of increased load torque. The unit operates from the 115 volt, 60 cycle a-c line and finds many laboratory and industrial uses.

Portable Television

HAROLD SHEVERS, INC., 123 W. 64th St., New York 23, N.Y., has available the portable Gotham television measuring 19 in. × 17 in. × 10 in., and weighing 29 lb. Picture tube is the General Electric 8½-in. type. Tuning is done with two controls. All other controls are accessible through a front flap. It is instantly convertible to uhf and has standard components throughout. List price in airplane cloth is $199.95.

Continuously Variable Delay Line

ADVANCE ELECTRONICS CO., P. O. Box 394, Passaic, N. J. Type 302 distributed-parameter line is capable of providing continuously variable time delay from zero to 0.6 μsec. Some of its advantages are complete freedom of time jitter, very fast rise time, no limit on repetition frequency, greater bandwidth and excellent transient response. Characteristic impedance is 960 ohms nominal. Attenuation in db per 100 millimicrosecond delay is: approximate zero below 1 mc, 0.3 at 5 mc, 0.95 at 10 mc, 1.3

Do you know that ALTEC makes

Microphones... 6 MODELS

Loudspeakers... 14 MODELS

Horns... 18 MODELS

Theatre Systems... 9 MODELS

Transformers... 159 DESIGNS

Amplifiers... 22 MODELS

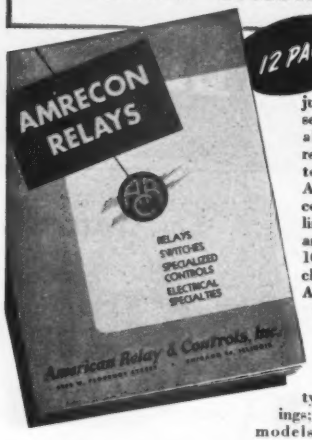
—plus hundreds of special audio devices and transformers for the Armed Forces, the United States government, Research organizations and leading testing laboratories.

...the best investment

ALTEC LANSING CORPORATION

8356 Santa Monica Blvd., Beverly Hills, Calif.
161 Sixth Avenue, New York 13, New York

NEW! AMRECON RELAY CATALOG



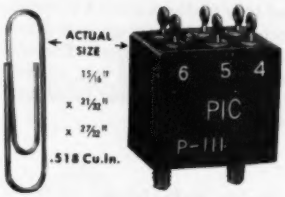
This useful catalog shows just how to go about selecting a relay, with all the information required to fit the unit to the application! Also describes the complete AMRECON line, with illustrations and data on each of 10 basic models (including both D.C. and A.C. types) and their variations. Includes a discussion of snap-action and latching relays; screw terminal types; plug-in mountings; hermetically sealed models, and other data.

WRITE ON COMPANY LETTERHEAD FOR YOUR COPY TODAY!

American Relay & Controls, Inc.
4911 W. Flournoy St., Chicago 44, Ill.

New!

PIC* Ferrite Pulse Transformer



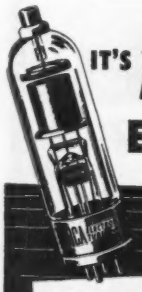
Fits in Half the Space!

Features: Shorter Rise Time
MIL-T-27 or Commercial
Wider Frequency Response
Complete Interchangeability with Conventional Transformers

Other Ferrite transformers designed to your circuits or specifications

*POLYPHASE INSTRUMENT COMPANY

765 Lancaster Ave.
BRYN MAWR, PA.



IT'S ALLIED FOR RCA

Electron Tubes for Industry

ALL TYPES IN STOCK

- Vacuum Power
- Thyratrons
- Vacuum & Gas. Rect.
- Ignitrons
- Cold-Cathods
- Phototubes
- Oscillograph Tubes
- Camera Tubes
- Monoscopes
- Special Types

FREE Interchangeability Directory

Valuable guide to selection of proper RCA tube type replacements. Lists 1600 tube types. Write for FREE RCA Guide No. 37-046.

Quick, Expert Service on RCA Tubes

ALLIED maintains in stock *for quick shipment*, the world's largest distributor inventory of RCA special-purpose tubes—*of all types*. We specialize in supplying the needs of industrial, broadcast, governmental and other users. To save time, effort and money—phone, wire or write to ALLIED. Fill *all* your needs quickly from the *complete, dependable* electronic supply source.

See Your 1952 ALLIED Catalog

Refer to your ALLIED Catalog for *all* electronic supplies—parts, tubes, test instruments, tools, audio amplifiers, accessories—available from the world's largest stocks. Write today for your FREE copy of the *complete* 212-page ALLIED Catalog.

FREE! Send for it now

ALLIED RADIO
833 W. Jackson Blvd., Dept. 11-C-2, Chicago 7, Ill.

Everything in Electronics from ONE Source

Over 85% of the torque wrenches used in industry are

STURTEVANT TORQUE WRENCHES

Read by Sight, Sound or Feel.

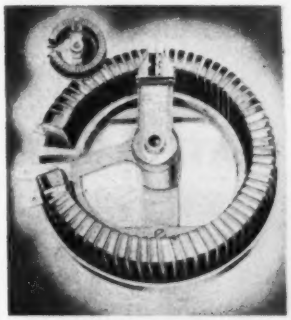
- Permanently Accurate
- Practically Indestructible
- Faster—Easier to use
- Automatic Release
- All Capacities

(in inch ounces . . . inch pounds . . . foot pounds (All Sizes from 0-6000 ft. lbs.)

Every manufacturer, design and production man should have this valuable data. Sent upon request.

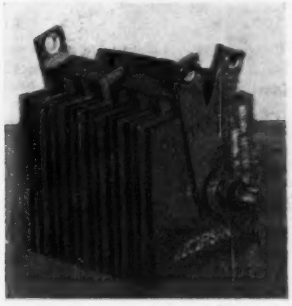
PA Sturtevant Co

at 20 mc and 1.5 at 30 mc. A descriptive bulletin is available.



Power Rheostats

P. R. MALLORY & Co., INC., 3029 E. Washington St., Indianapolis 6, Ind., has placed in production a line of vitreous enamel power rheostats. The rheostats will be available in seven sizes, ranging from 50 to 500 w. They will be interchangeable with the vitreous enamel power rheostats produced by the rest of the industry, but feature an exclusive patented hinged contact arm that insures long life and freedom from burn-outs.



Selenium Rectifiers

KOTRON RECTIFIER CORP., 54 Clark St., Newark 4, N.J., produces rectifier cells from 1 by 1 in. to 5 by 6 in. assembled in all circuit arrangements for any voltage or current considerations. The company's newest product is a selenium cell with capacity to withstand 60 volts rms. All cells are custom processed to various controlled blocking voltages and current densities. The

CONCENTRATE!

on the one line that does every job!

Permacel ELECTRICAL TAPES

YOUR REQUIREMENT:	TAPES:
HIGH-VOLTAGE INSULATION	P-30 Heavy-Duty Vinyl Insulating P-25 Clear Acetate Film P-251 Orange-Yellow Acetate Film P-241 Acetate Cloth Film
NONCORROSIVENESS	P-24 White Acetate Cloth P-242 Colored Acetate Cloth
HEAVY-DUTY HOLDING	P-20 Cotton Cloth
QUICK AND POSITIVE ANCHORING	P-27 Yellow Flatback Paper P-23 Black Flatback Paper
SNUG CONFORMANCE	P-29 Electrician Vinyl Insulating P-22 Black Crepe Paper P-28 Yellow Crepe Paper
HIGH HEAT-RESISTANCE	P-301 H. C. (Heat Curing) Cotton Cloth

All PERMACEL Electrical Tapes have special solvent resistance and high baking stability characteristics which permit greater safety tolerances in production.

And PERMACEL gives you complete service. From supplying technical men to working out your particular tape problems...to making tapes to your order. So concentrate on PERMACEL and simplify your work.

INDUSTRIAL TAPE CORPORATION
NEW BRUNSWICK, N. J.

Makers of Texcel® Cellophane Tape, and a complete line of pressure-sensitive tapes for industry.

For complete information MAIL HANDY COUPON BELOW!

PERMACEL ELECTRICAL TAPES
INDUSTRIAL TAPE CORP.
NEW BRUNSWICK, NEW JERSEY, DEPT. 4R

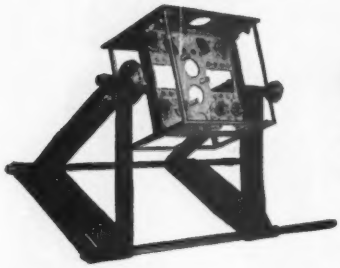
CHECK ONE OR BOTH:

☐ Please have representative call on me
☐ Place me on your mailing list

COMPANY NAME .....
STREET .....
CITY ..... ZONE ..... STATE .....
YOUR NAME .....
TITLE .....

SPEED your assembly lines with our

WIRING FIXTURES



1. Can be loaded and unloaded in two seconds.
2. Indexed 360° fixture to hold chassis in any position to step up soldering and all other assembly operations.
3. Adjustable to any size to base limits of the Jig.
4. Sturdy, rigid construction.
5. Holding adapters to fit your chassis.
6. Saves spoilage.

LOOK US UP AT BOOTH 351 I R E SHOW GRAND CENTRAL PALACE

SPECIAL DESIGNS to solve your production problems. We invite your inquiry.

Write or Wire for detailed information and literature.

PRODUCTION TOOL & FIXTURE CO.

37 WEST MAIN STREET, OYSTER BAY, N.Y.

They can take it!

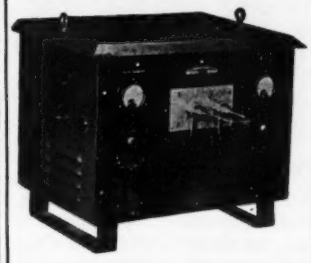
DX XTALS
THE HEART OF A GOOD TRANSMITTER

-and dish it out!

DX RADIO PRODUCTS CO.

GENERAL OFFICES: 2300 W. ARMITAGE AVE., CHICAGO 47, ILL.

2 KW VACUUM TUBE BOMBARDER OR INDUCTION HEATING UNIT



For Only $650.

Never before a value like this new 2-KW bench model "Bombarder" or high frequency induction heater . . . for saving time and money in surface hardening, brazing, soldering, annealing and many other heat treating operations.

Simple . . . Easy to Operate . . . Economical Standardization of Unit Makes This New Low Price Possible.

This compact induction heater saves space, yet performs with high efficiency Operates from 220-volt line. Complete with foot switch and one heating coil made to customer's requirements. Send samples of work wanted. We will advise time cycle required for your particular job. Cost, complete, only $650. Immediate delivery from stock.

Scientific Electric Electronic Heaters are made in the following ranges of Power: 1-2-3½-5-7½-10-12½-15-18-25-40-60-80-100-250KW.

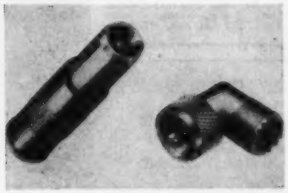
Scientific Electric

Division of

"S" CORRUGATED QUENCHED GAP CO.

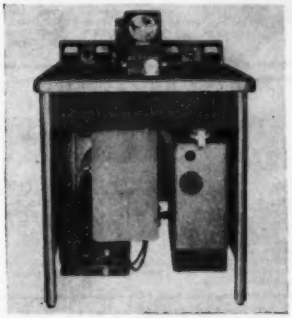
107 Monroe St., Garfield, N. J.

company mass produces rectifier cells especially for use in magnetic amplifiers. These cells at 20 volts rms have a blocking-to-conducting resistance ratio of approximately 1,600 to 1 in all cell sizes.



Coax Connectors

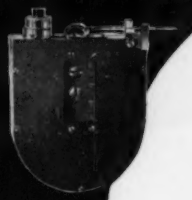
TRANSRADIO LTD., 138A Cromwell Rd., London, SW7, England, has developed a new series of precision coaxial connectors. Five groups are available to fit any coaxial outside diameter from 0.36 in. to 1.03 in. They may be had in elbow, straight and T-form type cable plugs. The series also includes a few types of U.S. JAN connectors.



Electron Microscope

FARRAND OPTICAL CO., INC., Bronx Blvd. & E. 238th St., New York 66, N. Y. Model ESTI electrostatic electron microscope features a resolving power of 30 angstrom units, freedom from astigmatism, ease of alignment, distortionless image at all magnifications, and consistent high image quality at direct magnifications up to 20,000 times. High voltage is continuously variable up to 30 kv. The power supply consists of a 60-cycle transformer, rectifier and doubler circuit. Overall design of the equipment has been

Edin instruments

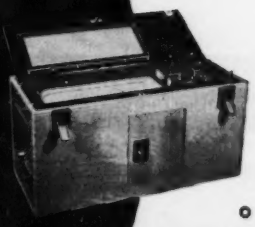


OSCILLOGRAPH GALVANOMETER

No's. 8001, 8002, 8003 and 8004 ink-writing galvanometers have sensitivities from 3.5 to 40 volts per cm., resonant frequencies from 15 to 120 cps., resistances from 1000 to 2000 ohms, frequency response up to 350 cps., and a single-jewel pivot construction. Units are designed for multiple operation up to 10 channels in a total width of 12 inches.

DIRECT-COUPLED AMPLIFIER

No. 8100 direct coupled amplifier has a voltage amplification of 13,000 with a maximum output of 70 volts. Frequency response from d.c. to 10,000 cps. is flat within 10%. Input impedance is 2 megohms; output impedance is 150 ohms. Input may range from 0.1 mv. to 100 volts. Stability is better than 0.1 mv. per thirty minutes, or 0.5 mv. per day. Attenuator is stepped for factors from 1 to 1000.



OSCILLOGRAPHS

Recorders can be supplied with 1, 3 or 9 chart speeds ranging from 0.1 mm./sec. to 250 mm./sec. See specifications of OSCILLOGRAPH GALVANOMETER for frequency range.

OSCILLOGRAPH AMPLIFIER

No. 8121 special amplifier has a time constant of 1 second, an exponential response to a square wave at high gain, input impedance of 1 megohm, and input form 0.1 mv. to 1000 volts. At low gain, No. 8121 becomes a DC amplifier with a voltage gain of 100 and an input of 10 mv./mm.

HIGH-GAIN AMPLIFIER

No. 8130 amplifier, has a voltage gain of 1,000,000 and includes a built-in pre-amplifier. Frequency response is from 1 to 200 cps. Input may range from 10 microvolts to 100 millivolts. This amplifier is particularly suited for Biological studies.

Many other types of recording and amplifier circuits are available and special equipment can be assembled to meet particular specifications.

EDIN COMPANY, INC.
207 Main Street
Worcester 8, Mass.

Please send complete information on:

☐ RECORDERS
☐ NO. 8121 AMPLIFIER
☐ GALVANOMETERS
☐ No. 8100 AMPLIFIER
☐ No. 8130 AMPLIFIER
☐ _____ SPECIAL (Enclose details)

_____ (NAME)

_____ (NO.) _____ (STREET)

_____ (CITY) _____ (STATE)

_____ COMPANY _____ POSITION

Regulated HIGH VOLTAGE SUPPLY

Continuously variable
300—2500 Volts D.C.
0—1 Milliampere

- **Line Stabilization:** ± .001% change in output for a ± 1% change in line Voltage (100 UA Load).
- **Load Stabilization:** ± .5% change in output for 1 MA at 2000 Volts or .5 MA at 2500 Volts.
- **Ripple:** Less than .1 Volt.

PRICE
$175.00

WRITE FOR
BULLETIN VS—202

NUCLEAR RESEARCH CORPORATION
2563 GRAYS FERRY AVENUE · PHILADELPHIA 43, PA.

Independent Research Proves:

2 out of 3 Engineers Prefer BURGESS BATTERIES!

NO WONDER Burgess is *the* first source for industrial dry batteries. Burgess long-life dependability and uniform, high-level performance are backed by more years of engineering "know-how" than any other batteries. The maintenance of highest quality always is the reason why 2 out of 3 engineers prefer Burgess . . . by independent survey. Check for your local source of supply or write NOW!

WRITE FOR ENGINEERING MANUAL AND CHECK SHEET—No obligation. By return mail you will receive the FREE Engineering Manual listing the complete line of Burgess Batteries together with detailed specifications; also the Burgess "Check Sheet" on which you may outline your battery requirements in the event that the battery you need has not already been developed. Address:

BURGESS BATTERY COMPANY
(DEPT. E-6) FREEPORT, ILLINOIS

MATHEMATICS FOR ENGINEERS

3rd Edition—Just Published

1. Covers every phase of mathematics the engineer is likely to meet, from algebraic notation, determinants and linear equations through differential calculus, curve analysis, integration, summation, etc. Revised third edition contains much added material, including chapters on Differential Equations and Dimensional Analysis, with emphasis on the Buckingham Pi theorem. By Raymond Duff and Richard Dull, Eng'r., Webster-Chicago Corp., 822 pp., illus., $7.50.

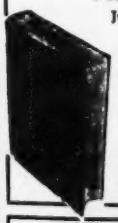
FUNDAMENTALS OF ATOMIC PHYSICS

Just Published

2. Gives engineers groundwork in atomic and nuclear fundamentals, in the simplest possible treatment. Covers the kinetic theory of gases, the charge and mass of electron, electronics, photoelectric effects, X-rays, the Bohr theory of the origin of spectral lines, electron configuration in atoms, etc. Deals with matter waves, isotopes, and other important factors. Supplies an understanding of the quantitative relations involved in atomic and nuclear structures. By Saul Dushman, Research Consultant, Gen. Elec. Co., Schenectady, N. Y. 294 pages, illus., $5.50.

TELEVISION PRINCIPLES

Just Published



3. A practical treatise on the principles and theory of television transmission and reception. Emphasizes basic TV transmitters and receiver design, and such subjects as video amplifiers, cathode followers, grounded-grid amplifiers, signal-to-noise ratios in head-line, intermediate frequency amplifiers, and detection. Contains helpful reference charts, curves, and tables. By Robert B. Dome, Elec. Consultant, Electronics Dept., Gen. Elec. Co. 281 pages, 90 illus., $6.50

ELECTRONIC MOTOR and WELDER CONTROLS

Just Published

4. Here is practical help for those who must select, install, or service electronic controls for motors and resistance welders. The book explains circuit operation of tube-operated equipment found in the two major groups of motor and resistance-welding control. Each chapter starts with an introduction to a complete electronic equipment and then splits it into its component circuits, pinpointing each operation with simple descriptions and diagrams. By George M. Chute, 348 pages, 187 illus., $6.50

SEE THESE BOOKS 10 DAYS FREE

McGRAW-HILL BOOK CO., 330 W. 42 St., NYC

Send me book(s) checked below for 10 days' examination on approval. In 10 days I will remit for book(s) I keep, plus a few cents for delivery, and return unwanted book(s) postpaid. (We pay for delivery if you remit with this coupon; same return privilege.)

- ☐ 1. Dull & Dull—MATH. FOR ENGS. $7.50
- ☐ 2. Dushman—FUN. OF ATOMIC PHYSICS. $5.50
- ☐ 3. Dome—TV PRINCIPLES, $6.50
- ☐ 4. Chute—ELEC. MOTOR & WELDER CONT., $6.50

(Print)
Name.....
Address.....
City.....Zone....State.....
Company.....
Position.....FL-3-52
This offer applies to U. S. only.

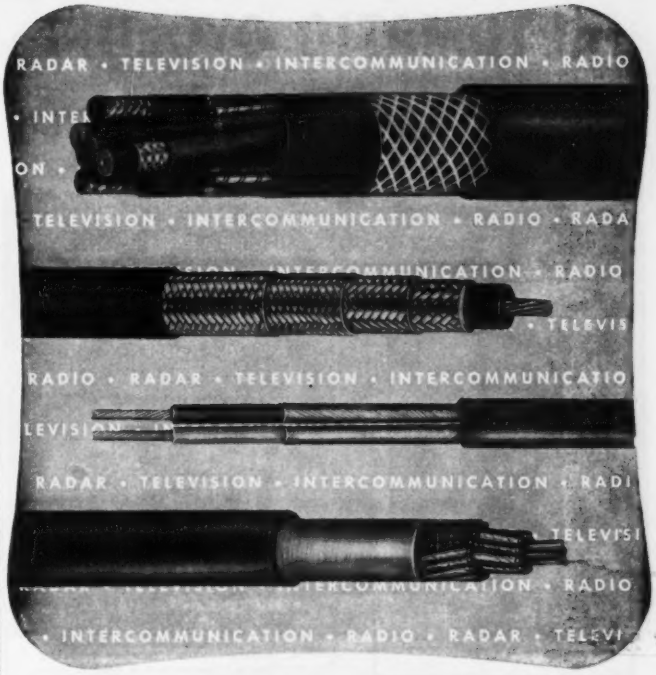
made in the interest of ready access to the component units, including the electron gun, the specimen holder and manipulator, the plate holder, the power supply, the gage system and the lenses.

Wire-Wound Resistors

CLAROSTAT MFG. CO., INC., Dover, N. H. Type PR5F Greenohms—5-watt fixed wire-wound resistors with the characteristic inorganic cement coating—are now available in the increased resistance values of 8,000, 8,500, 9,000 and 10,000 ohms. In the series A-C 10F or 10-watt Greenohms, the 9,000-ohm value has been added between the 8,500 and 10,000-ohm numbers.

Binding Post

KINGS ELECTRONICS CO., INC., 40 Marbledale Road, Tuckahoe, N. Y. Model K952 binding post incorporates the quick-disconnect principle with a spring-loaded action and stainless-steel locking jaws. Teflon insulation throughout provides low dielectric loss, no moisture disturbance, no carbon tracking and the maintenance of mechanical properties in the binding post tempera-


RADAR • TELEVISION • INTERCOMMUNICATION • RADIO
TELEVISION • INTERCOMMUNICATION • RADIO • RADA
RADIO • RADAR • TELEVISION • INTERCOMMUNICATIO
RADAR • TELEVISION • INTERCOMMUNICATION • RADI
• INTERCOMMUNICATION • RADIO • RADAR • TELEVI

For special cables go to specialists

. . . Rome Cable

Electronic wiring components must conform to exacting specifications for quality performance. This is particularly true in high frequency applications where sensitive and dependable operation is so important. Leading manufacturers turn to Rome Cable for their electronic needs . . . because they *know* their specification requirements will be met *exactly*.

Rome Cable has the facilities, experience and engineering "know-how" to produce complicated special cables of the highest quality, utilizing both rubber and thermoplastics, typical examples of which are shown above. This, coupled with a complete line of Underwriters' Approved standard radio and television hook-up wires (including military types), makes Rome your best source of supply. The coupon below will bring you descriptive literature. Mail it today.

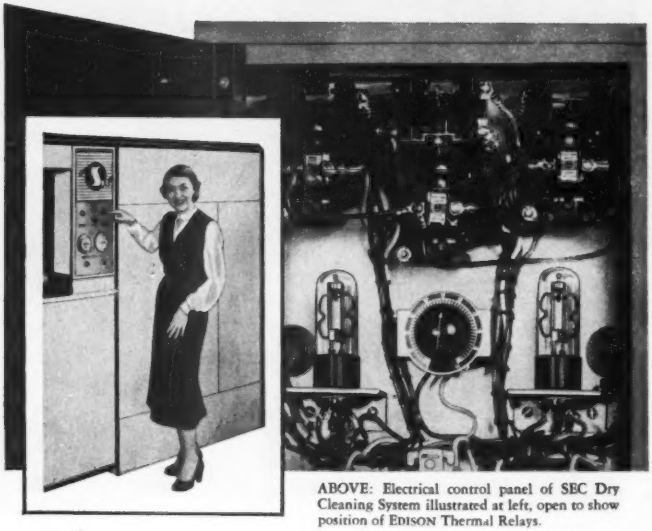
IT COSTS LESS TO BUY THE BEST

ROME CABLE CORPORATION
Dept. E-3 • Rome, N. Y.
Please send me information on Electronic Wiring.

Name.....
Company.....
Address.....
City ..... State .....

ROME CABLE CORPORATION
ROME, NEW YORK and TORRANCE, CALIFORNIA

AUTOMATIC CYCLING
Simplified by EDISON *Relay*



ABOVE: Electrical control panel of SEC Dry Cleaning System illustrated at left, open to show position of EDISON Thermal Relays.

THE SEC-O-MATIC CORP. chose the EDISON Model 501 Time Delay Relay to provide an automatic delay period in the washer and extractor cycles of their SEC automatic dry cleaning system.

THE EDISON TIME DELAY RELAY was selected because of its long dependable service record in many industrial applications, its low cost, and plug-in feature.

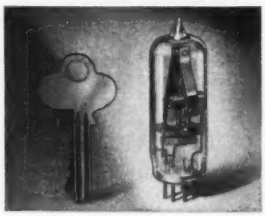
HOW IT WORKS—The heater of the EDISON delay relay is in the circuit between the washing timer and the washing motor starter relay. When the timer is set, the heater of the delay relay is energized and a valve is opened allowing the cleaning fluid to reach its level in the washing tank. The delay relay then closes its contacts and the washing motor begins its agitating cycle.

AT THE END of the washing cycle, the washing timer closes the extractor circuit which energizes the heater of the second delay relay and reverses the valve to drain the washing tank. When the contacts close, the centrifugal dryer is set in motion.

AUTOMATIC DELAYS are only one of the many uses found for this EDISON relay. Send now for further details. Bulletin E4-3007 will be sent free.

Thomas A Edison
INCORPORATED
Instrument Division
51 Lakeside Avenue, West Orange, N. J.

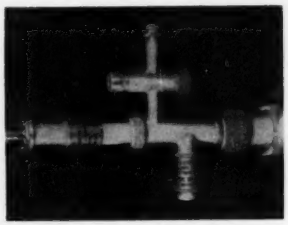
MANUFACTURERS OF
Electrical Resistance Bulbs
Temperature Indicating and Alarm Systems
Sealed Thermostats



ASK FOR Bulletin E4-3027 on the new EDISON *Miniature* Thermal Relay.

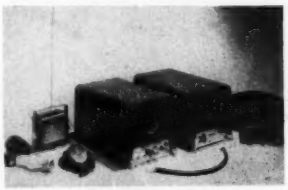
YOU CAN ALWAYS RELY ON EDISON

ture application range of 67 F to 149 F. Complete moisture sealing is effected on the chassis itself by a special Teflon and rubber combination.



Coaxial Crystal Mixer

EMPIRE DEVICES, INC., 38-25 Bell Blvd., Bayside 61, N.Y., has developed model CM-107 fixed-tuned coaxial crystal mixer. Input vswr is better than 2 to 1, without adjustments, for all frequencies within the nominal frequency range. Local oscillator power requirements is 10 mw. Oscillator injector is adjustable to accommodate large variations in oscillator power. Local oscillator rejection at i-f output is better than 30 db. Frequency ranges in the standard models run from 225 to 2,600 mc.



Mobile Radio

GENERAL ELECTRIC CO., Syracuse, N. Y., has announced new 25 to 50-mc mobile radio communications equipment for operation in both 20-kc and 40-kc channel widths and featuring quadra-tuned i-f transformers in the receivers. Five high-Q tuned circuits between the antenna and first converter improve reception and reduce interference. Using the 20-db quieting method, the receiver for 20-kc operation has selectivity of 100 db down at ±20 kc. By the same method, the 40-kc receiver has selectivity of 100 db

Military Radio and the Radio Engineering Show

EXHIBITS

A major feature of the Radio Engineering Show, March 3–6, 1952 at Grand Central Palace, New York, will be a cooperative IRE-Exhibitor display of Military Radio Equipment.

This exhibit occupies 2448 sq. ft. in a large island on the fourth floor at the Palace. 21 firms exhibiting in the Show are supplying complete apparatus, and nearly 200 other exhibitors are represented by components and materials, etc., in this display.

SESSIONS

Most of the 42 Technical Sessions and Symposiums of the 1952 I R E Convention have Military importance. However, nine have direct Military Radio information. These Are:

March 3, pm New Developments in Telemetering
March 4, am Microwaves I "Waveguides A"
March 4, pm Microwaves II "Waveguides B"
March 5, am Symposium: Digital Computors in Control Systems
March 5, pm Radar and Radio Navigation
March 5, pm Symposium: Magnetic-Core Memory Devices for Digital Computors
March 6, am Symposium: Integration of Electronic Equipment with Airframe Design
March 6, am Digital Computors
March 6, pm Reliability of Military Electronic Equipment

Cooperation

is making this Military Radio Exhibit a great achievement, reflecting properly the importance of Military Radio to our industry. Credit goes to many exhibitors, to the Technical Papers Committee, and to members of the MR Exhibit Committee, including W. W. MacDonald, well known to readers of Electronics.

Registration: Members, $1., Non-Members, $3.

ASTRON

SEE US at the WALDORF-ASTORIA in New York for the I. R. E. SHOW

"METALITE"
METALLIZED PAPER CAPACITORS

save space

without sacrificing Quality!
Ultra-compact—light in weight—
self-healing—proved dependable under
severe operating conditions—universally accepted
on the basis of performance.

Write for Catalog AC-3, for the full story on METALITE, and all Astron products

ASTRON CORPORATION — 255 Grant Avenue, East Newark, New Jersey
Export Division: ROCKE INTERNATIONAL CORP., 13 E. 40th St., N. Y. 16
In Canada: CHARLES W. POINTON, 1926 Gerrard Street East, Toronto

DEPENDABLE . . . COMPACT . . . EFFICIENT
Carter Rotary Power

Carter DC to AC Converters, Dynamotors, Genemotors, Magmotors, and Inductor Alternators (inverters) are made in a wide variety of types and capacities adaptable to communications, laboratory, and industrial applications, of many kinds. Widely used in aircraft, marine, and mobile radio, geophysical instruments, laboratory work, ignition, timing and many other uses.

Carter Motor Co.
2646 N. Maplewood Ave., Chicago 47
Sales Offices in Principal Cities

MAIL COUPON FOR CATALOGS

Please send catalogs containing complete information on Carter Rotary Power Supplies.

Name_____
Address_____
City_____ State_____

*Trade Mark Registered

Picture shows Jennings Type VMMC *and* UCSX *in Mackay Transmitter*

WIDE RANGE MOTOR TUNING

Simplified by use of

JENNINGS VAC. CAPACITORS

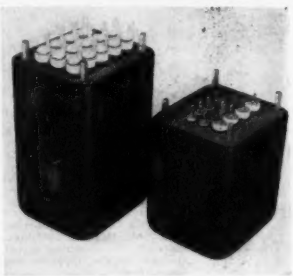
Mackay Radio, a unit of the American Cable & Radio System, has utilized the Jennings Vacuum Variable Capacitor to make their modern telegraph stations as free from harmonic radiation as possible. The upper left corner of picture shows a Jennings type UCSX-500 in the output of the double Pi network. The lower center is a Jennings type VMMC-2000 which is the coupling for the Pi network. Without these miniature, compact components, trouble-free harmonic rejection circuits would not be feasible. This Transmitter employs Jennings Vacuum Variable Capacitors throughout, with the exception of two small air variables in the multiplier stages.

The Jennings Vacuum Variable Condensers make direct motor tuning, without switching through the full frequency range, possible, as employed in 30 KW Mackay Radio Point-to-Point Transmitters.

Write us for information regarding your own Capacitor problem. Literature mailed on request.

JENNINGS RADIO MANUFACTURING CO. • 970 McLAUGHLIN AVE. • P.O. BOX 1278 • SAN JOSE 8, CAL.

down at ±30 kc. The 30-w transmitter has standby battery drain of 2.3 amperes and transmitting drain of 38 amperes at 6.3 v. The 60-w, 6.3-v transmitter has standby battery drain of 3.2 amperes and transmitting drain of 50 amperes. Receiver battery drain is 6 amperes at 6.3 v, and 3 amperes at 12.6 v.



Electrical Insulation

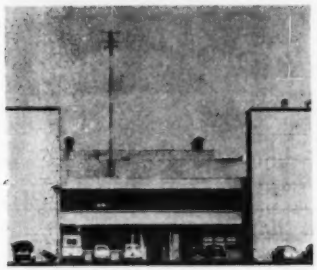
JOHNS MANVILLE, 22 E. 40th St., New York 16, N. Y., is now offering Quinterra type 3, an asbestos-base, silicone-treated, high temperature electrical insulation. It is a class H insulation, as defined by AIEE standards, for service at a temperature of 180 C. It is used for both interlayer and wire wrapping insulation, and is adaptable to a wide range of electrical devices including air-cooled, inert gas and silicone-filled transformers. The picture shows the savings in space and materials made possible in similarly rated transformers. The transformer at the right is built using silicone-treated Quinterra type 3 insulation.

Double Pulse Generator

BERKELEY SCIENTIFIC CORP., 2200 Wright Ave., Richmond, Calif. Model 903 double pulse generator is designed for general laboratory

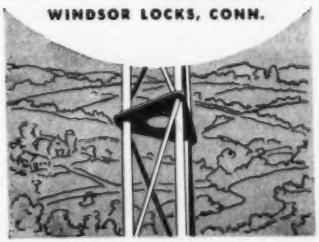
VEE-D-X
Sectional Tower

MOST ECONOMICAL FOR MICROWAVE · FM · TV COMMUNICATIONS · RADAR

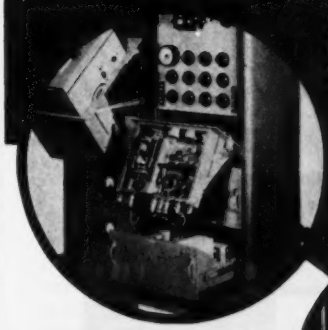


Pan American World Airways installation at Idlewild. Tower carries one 40 mc ground-plane antenna, six half-wave vertical 100 mc antennas, two weather instruments and a full set of obstruction lights.

THE LaPOINTE-PLASCOMOLD CORP.
WINDSOR LOCKS, CONN.



STAR of the SHOW



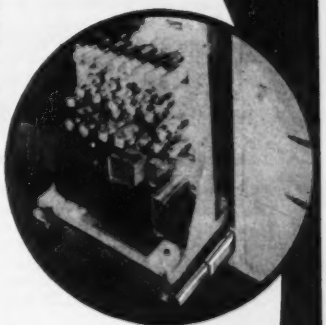
Automatic Transmission Measuring Set developed by Bell Telephone Labs. Units are suspended on Grant Slides. Slides permit chassis to be inverted for servicing.

Typical cabinet installation used by Sperry Gyroscope Co., Great Neck, N. Y. All units are supported by Grant Electronic Equipment Slides which yield quick accessibility for repair and maintenance.

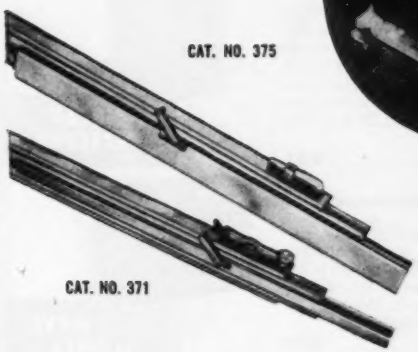
GRANT Electronic SLIDES

Three section slide, progressive action type. Locks in extended position only. Tripping mechanism controls unlocking. Load capacity: Up to 200 lbs. — CAT. NO. 375

Three section slide, progressive action type. Locks in extended position only. Thumb release controls unlocking. Load capacity: Up to 200 lbs. maximum — CAT. NO. 371



The Dumont Telecruiser, a mobile TV station, features Grant Electronic Equipment Slides as a component part for simplified servicing.



CAT. NO. 375

CAT. NO. 371

Grant's Engineering and Research Departments are available for consultation on individual requirements.

The foremost name in Sliding Devices

GRANT PULLEY & H'DW'E CO.
31-87 Whitestone Parkway, Flushing, N. Y.

GRANT

Meet us at I.R.E. Show Booth 462 Grand Central Palace N. Y.

B&W
Precise
AUDIO TESTING
for designing, production checking, research or "proof of performance" FCC tests for broadcasters.

A low-distortion source of audio frequencies between 30 and 30,000 cycles. Self-contained power supply. Calibration accuracy ±3% of scale reading. Stability 1% or better. Frequency output flat within 1 db, 30 to 15,000 cycles.
MODEL 200 . . . . . $138
AUDIO OSCILLATOR

For fundamentals from 30 to 15,000 cycles measuring harmonics to 45,000 cycles; as a volt and db meter from 30 to 45,000 cycles. Min. input for noise and distortion measurements .3 volts. Calibration: distortion measurements ±5 db; voltage measurements ±5% of full scale at 1000 cycles.
MODEL 400 . . . . . $168
DISTORTION METER

Combines RF detector and bridging transformer unit for use with any distortion meter. RF operating range: 400 kc to 30 mc. Single ended input impedance: 10,000 ohms. Bridging impedance: 6000 ohms with 1 db insertion loss. Frequency is flat from 20 to 50,000 cycles.
MODEL 404 . . . . . $85
LINEAR DETECTOR

Speeds accurate analysis of audio circuits by providing a test signal for examining transient and frequency response . . . at a fraction of the cost of a square wave generator. Designed to be driven by an audio oscillator.
MODEL 250 . . . . . $10
SINE WAVE CLIPPER

The instruments of laboratory accuracy

Bulletin EL-32 gives complete details

Barker & Williamson, Inc.
237 Fairfield Avenue • Upper Darby, Pa.

See Us at the IRE Show—Booth-N-2

work. It produces either single or double pulses such that the amplitude and width of each pulse is continuously and individually variable. The unit is capable of producing either positive or negative pulses. The amplitude of negative pulses is individually and continuously variable from 200 v maximum into a 1,000-ohm load and 10 v maximum into a 50-ohm load. Amplitude of positive pulses is continuously and individually variable from 50 v maximum into a 1,000-ohm load and 2.5 v maximum into a 50-ohm load. Separation of the pulse pairs is continuously variable from 0 to 10 μsec and can be read directly on a calibrated knob on the front panel. Rise time of the pulses is 0.035 μsec and decay time less than 0.15 μsec. Pulse width is individually variable from 0.1 to 1.8 μsec. Repetition rate is internally controllable from 1 to 1,000 pulses per second.

Electronic Flasher

HALEDY ELECTRONICS CO., 57 William St., New York City 5, N. Y., recently announced a lightweight, portable electronic signal flasher without moving parts or filaments to burn out. The flasher, of cold cathode tube design, emits a sharp brilliant flash of light clearly visible for approximately a mile. It weighs 8½ lb. The unit uses a set of three standard 90-volt batteries in series. An off/on switch as well as an outside knob to control the number of flashes per minute is provided. A

Production capacity has recently been expanded to supply your increasing demand for vibrators and vibrator power supplies. Engineering facilities are available for designing vibrators and power supplies to your specifications.

Victoreen has two standard vibrator power supplies for use with battery-operated portable equipment such as Geiger counters, photo-multipliers, and electronic equipment requiring a high voltage supply. These compact units have been potted and hermetically sealed to make them reliable and rugged. They contain regulator circuits to stabilize their outputs. Net weight is only one pound.

- THE MODEL 517 VIBRATOR POWER SUPPLY operates from 4.5 volts dc and supplies +900 volts at 5 microamperes and +58 volts at 0.25 milliamperes.
- THE MODEL 532 VIBRATOR POWER SUPPLY operates from 3.0 volts dc and supplies —900 volts at 15 microamperes and +58 volts at 0.25 milliamperes.

The precision vibrators which are used in these power supplies are available separately. They have been mounted in sponge rubber and hermetically sealed, and are invaluable for such applications as high voltage power supplies, portable Geiger counters, scintillation counters, and portable radios. These plug-in units weigh only 2½ ounces.

- THE MODEL 531 VIBRATOR is designed to operate from a 1.5 or 1.3 volt battery and requires as little as 18 milliwatts driving power.
- THE MODEL 532 VIBRATOR is also an 18 milliwatt unit, but designed for operation in series with the primary of a transformer and from a 1.5 to 6 volt battery.

BETTER COMPONENTS MAKE BETTER INSTRUMENTS

Victoreen
Instrument Co.
5806 HOUGH AVE.
CLEVELAND 3, OHIO

Custom Built
Electronic Components

Micro-Wave components include radar filters—cross bar switches—magnetic tuners—crystal holders—crystal converters—dial assemblies—jacks and connectors—coil forms—crystal heater ovens—cavity tuners and cathode-ray tube parts.

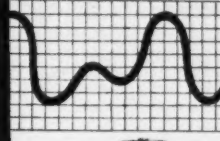
Precision machined parts, stampings and castings used in communication and aircraft industries.

★ Fabricated in beryllium copper, molybdenum, tantalum, monel, plexiglass and polystyrene.

Competent engineering and experienced design assistance is available.

JOHN GOMBOS CO., Inc.
103-109 Montgomery Ave. ESSEX 3-6633 Irvington 11, N. J.
See Us at Booth 263—Radio Engineering Show

timing....
unaffected by voltage fluctuations



AN
AGASTAT
TIME DELAY RELAY for every requirement

A·G·A 1027 NEWARK AVE., ELIZABETH 3, NEW JERSEY

A·G·A AGASTAT TIME DELAY RELAY
A·G·A STIMSONITE REFLECTORS
A·G·A AIRPORT LIGHTING
A·G·A MARINE LIGHTING EQUIPMENT

LAMINATED
MINIATURE
Tube
Sockets

. . . . . With Softer Alloy **Tube Pins** resulting from material conservation measures, the *wiping action* of METHODE laminated miniature socket contacts becomes of even more advantage, permitting uniform withdrawal of tubes without breakage, stress or damage to pins . . . .

Seven pin sockets are furnished with ⅞", 1", and 1-5/16" mounting centers; nine pin sockets with 1⅛" and 1-5/16" mounting centers. Available in production quantities in all standard grades of sheet phenolic and mica filled hard rubber insulation.

METHODE "Spring-Wipe" terminals *feature large gripping and conducting surface bearing on tube pins, insure minimum contact resistance and maximum insertion and retention characteristics. Proved outstanding performance and uniformity in millions of trouble free installations by the Industry's leaders.*

METHODE Products that prove production and precision skills

- Laminated Tube Sockets
- Subminiature Sockets
- Molded Tube Sockets
- Special Terminal Boards and Blocks
- Panel Connectors
- Tube Shields

METHODE Manufacturing Corp.
2265 West St. Paul Avenue • Chicago 47, Illinois

Geared to produce Plastic and Metal Electronic Components

clear or colored precision Fresnel lens protects the lifetime cold-cathode tube.

Solder Pot

DEE ELECTRIC CO., 1101 N. Paulina St., Chicago 22, Ill., has announced a new model thermostatically controlled solder pot that features a deeper crucible 4¼ in. deep × 1¾ in. diameter, for tinning Formvar wire and long leads. An adjustable thermostat makes possible close control over solder temperature for rapid and precision work. Dependency on constancy of line voltage is eliminated. It is available in 4 temperature ranges: model 41, maximum 1,200 F, minimum 800 F; model 42, maximum 1,000 F, minimum 700 F; model 43, maximum 800 F, minimum 500 F; and model 44, maximum 600 F, minimum 400 F.

High-Q Traps

JERROLD ELECTRONICS CORP., N. E. Corner 26th & Dickinson Sts., Philadelphia 46, Pa., has introduced a new line of high-Q traps designed for use between the tv antenna and receiver to eliminate adjacent channel and f-m interference. They are

OLD-FASHIONED SATURABLE REACTORS

had a lot of desirable characteristics. But there were a lot of jobs for variable inductances that they just couldn't do.

AT THE I.R.E. SHOW LAST YEAR

we introduced a new member of the saturable reactor family: the C.G.S. INCREDUCTOR.

WE KNEW OUR INCREDUCTOR*

could do a lot more jobs than its ancestor—the saturable reactor. But we didn't know it would be called on so rapidly to solve so many vexing problems in such diversified fields.

EVEN IF THERE WEREN'T ANY

security regulations—we couldn't begin to name all the different kinds of jobs that engineers have been turning over to C.G.S. INCREDUCTORS this past year.

SINCE THE LAST I.R.E. SHOW

we have been busy filling orders for our standard INCREDUCTOR variable inductance units and for INCREDUCTORS with special characteristics for unusual jobs.

HERE ARE SOME OF THE REASONS

so many jobs are being done better with C.G.S.

INCREDUCTORS:

(1) Greater change in inductance: 400 to one—as much as 600 to one in special applications.

(2) Smaller size—higher inductance values.

(3) Higher frequency operation (in the megacycles) with good efficiency and high Q.

The INCREDUCTOR has all of these advantages plus all the desirable characteristics of old-fashioned saturable reactors—such as continuous smooth change in inductance without moving parts.

OF COURSE WE'LL BE BACK

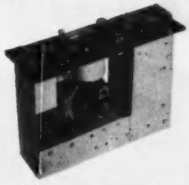
at the I.R.E. show this year. We invite you to visit us at our booth N-4 to watch a demonstration of the INCREDUCTOR, or to discuss your specific problem and how the INCREDUCTOR may help you solve it. We would like you to see our other C.G.S. products too.

C.G.S. LABORATORIES, INC.
391 Ludlow Street, Stamford, Conn.

* Trade Mark for our variable inductors.

SANBORN
RECORDING EQUIPMENT

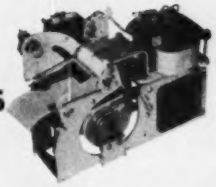
AMPLIFIERS



GENERAL PURPOSE—AC operated driver amplifiers; comprising three direct coupled push-pull stages.

STRAIN GAGE—Modulated carrier type for use with strain gage and resistance thermometer elements; strain gage, differential transformer, and variable reluctance transducers.

RECORDERS

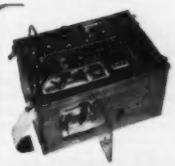


ONE-, TWO-, AND FOUR-CHANNEL. Permanent records produced by inkless, heated stylus on plastic coated paper in true rectangular coordinates. May be used in ANY position. Extremely rugged.

SEPARATELY or in COMBINATION

INTERCHANGEABILITY of Preamplifiers and Amplifiers permits recording of many different types of phenomena.

Any of the recording channels in the three systems at the right may include *either* a Strain Gage or General Purpose Amplifier, or the latter in combination (in 2-, and 4-channel systems) with either AC or DC Preamplifiers. For, any of the Amplifiers or Preamplifiers provided for in a system may be quickly *removed* from its place in the system and as quickly *replaced* with an alternate type.



SINGLE-CHANNEL Recording Systems—comprising *either* a General Purpose or Strain Gage Amplifier in combination with a one-channel Recorder Assembly. Standard paper speed at 25 mm/sec., slower speeds available. Paper width 6 cm with 5 cm recording area.

TWO-CHANNEL Recording System—Two channels operate independently of each other, but record simultaneously. Eight paper speeds. Timing and coding. Each channel 5 cm. recording width.

FOUR-CHANNEL Recording System—Up to four phenomena on one record, using the same principles and methods as the two systems above. Eight paper speeds. Provision for use of 4-, 2-, or 1-channel recording paper.

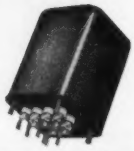
Write for completely descriptive, illustrated catalog.

SANBORN COMPANY
CAMBRIDGE 39 MASSACHUSETTS

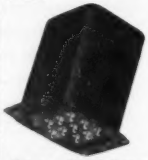
world's toughest transformers

CHICAGO "SEALED-IN-STEEL" New Equipment Line

AVAILABLE IN THREE VERSATILE CONSTRUCTIONS



H-Type. Steel base cover deep-seal soldered into case. Terminals hermetically sealed. Ceramic bushings. Stud-mounted unit. *Meets MIL-T-27 Specifications.*



S-Type. Steel base cover fitted with phenolic terminal board. Convenient numbered solder lug terminals. Flange-mounted unit.

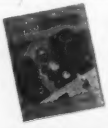
C-Type. With 10" color-coded stripped and tinned leads brought out through fibre board base cover. Flange-mounted unit.

Preferred!

the INSIDE STORY tells why!

The proof of toughness is on the *inside*—the actual proof that demonstrates why CHICAGO Transformers are preferred by engineers, why they fully meet the express requirements of today's tubes and circuits. Here are the "inside facts" of CHICAGO "Sealed-in-Steel" design:

1. Exclusive one-piece drawn-steel case, unsurpassed for strength, moisture-resistance, better electrostatic and magnetic shielding, mounting ease, and streamlined appearance.
2. Uniformly-wound precise coil structures—cooler operation and better electrostatic shielding in power units—minimum leakage, optimum coupling in audio units.
3. Core of high-grade non-aging silicon steel brought to high efficiency by scientific heat-treating in CHICAGO'S own annealing ovens.
4. Core and coil vacuum-impregnated with varnish. Final high-temperature baking achieves a perfectly impregnated coil and core locked against vibration.
5. All internal free space is filled by special, moisture-resistant compound. Prevents corrosion and helps maintain far cooler operation than in conventional air-surrounded mountings.
6. Checked by quality controls at every stage of manufacture, rigidly inspected, "torture-chamber"-tested to insure long, dependable life in actual service.



SEND FOR "NEW EQUIPMENT LINE" CATALOG

You'll want the full details on CHICAGO'S New Equipment Line—the famous Sealed-in-Steel line that offers advanced engineering design to fit today's circuits. Lists units for all purposes: Power, Bias, Filament, Filter Reactor, Audio, MIL-T-27, Modulation, Stepdown and Isolation. Write for your FREE catalog today—or get a copy from your distributor.

CHICAGO TRANSFORMER

DIVISION OF ESSEX WIRE CORPORATION

3501 ADDISON STREET • CHICAGO 18, ILLINOIS

CHICAGO TRANSFORMER TRADE MARK REG.

available in four models. Model TLB covers the low-band tv channels 2 through 6, from 54 to 88 mc; model THB traps out adjacent channel interference on high band tv channels 7 through 13, from 174 to 216 mc; interference from f-m stations is trapped by using model TFM, covering the 88 to 108-mc range; and model T Special is built on order to eliminate interference in bands other than vhf tv and f-m. The traps consist of bridged T networks with variable series and shunt inductance circuits. With both circuits tuned to the signal to be trapped the undesired signal is attenuated by a minimum of 50 db. The tv channel to be received is attenuated by a maximum of only 2 db. Each trap is priced at $25.00.

Branching Networks

THE DAVEN CO., 191 Central Ave., Newark, N. J., announces availability of the series 1130 branching networks. The multiple input and output networks are used to equalize incoming signal levels in multichannel mixers and similar broadcast equipment, and to combine two or more incoming lines into a single outgoing line or to divide one incoming line into two or more outgoing lines. They may be obtained in either balanced H or unbalanced T circuits. The resistors are of the precision wire-wound type with accuracy of ± 2 percent. The multiple networks frequency range is from 0 to 50 kc for most values.

Proportional Counter

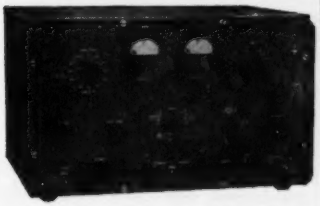
NUCLEAR MEASUREMENTS CORP., Indianapolis, Ind., has designed and

Check up ✓ CHECK OUT

WITH **SIGNAL GENERATORS**

by

AIRCRAFT RADIO Corporation



TYPE H-14 108-132 MEGACYCLES

Standard signal source for complete testing of VHF airborne omnirange and localizer receivers in aircraft or on the bench is ARC's Type H-14 Signal Generator. It checks up to 24 omni courses, omni course sensitivity, to-from and flag-alarm operation, left-center-right on 90/150 cycle and phase-localizers, and all necessary quantitative bench tests. Permits quick, accurate, check-out of aircraft just before take-off. For ramp checks RF output 1 volt into 52 ohm line; for bench checks, 0-10,000 microvolts. AF output available for bench maintenance and trouble shooting.

Price $885.00 net, f.o.b. Boonton, N. J.

Type H-12 VHF Signal Generator 900—2100 mc—source of cw or pulse amplitude-modulated RF. Power level 0 to −120 dbm. Internal pulse circuits with controls for width, delay, and rate, and provision for external pulsing. Frequency calibration better than 1%. Built to Navy specs for research, production testing. Equal to Military TS-419/U.

Price: $1,950.00 net f.o.b. Boonton, N. J.

AIRCRAFT RADIO CORPORATION
Boonton New Jersey
Dependable Electronic Equipment Since 1928

FUNGUS-PROOF

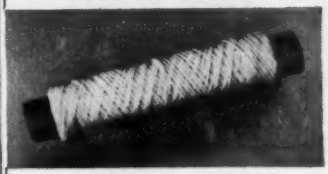
NYLON LACING CORDS

meet ARMY-NAVY and CIVILIAN Requirements

• Intensive research in the laboratories of Heminway & Bartlett has resulted in the development of a fungus-proof Nylon Lacing Cord. This new cord—with its special synthetic resin coating—resists the growth of mold and micro-organisms, factors most often responsible for the deterioration of old type linen and cotton lacing cord and the subsequent corrosion and failure of electronic equipment.

Heminway & Bartlett's new special finish Nylon Lacing Cord has high abrasion resistance . . . low moisture absorption. It retains the desirable malleability of wax and yet has a melting point of over 190° F. It is non-toxic to humans.

We'll be glad to send you full information and prices. Why not write us today!



LACING CORD (TYING TWINE)

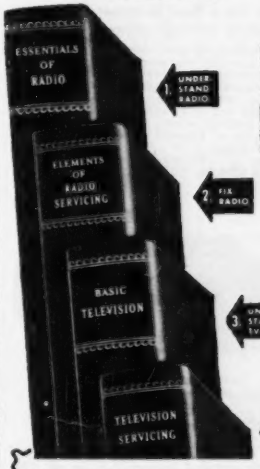
Write to Dept. EL:
The HEMINWAY & BARTLETT Mfg. Co.
500 Fifth Ave., New York 36, N.Y.
Branches: Chicago, Boston, St. Louis, Cincinnati, San Francisco, Charlotte, N.C., Gloversville, N.Y.

HEMINWAY & BARTLETT

NOW! **BECOME EXPERT AT**

Radio - Television

IN 4 EASY STEPS!



Complete Self-Training Course in RADIO and TELEVISION Prepared by Famous Experts—Starts From Scratch. Takes You BY SIMPLE LOGICAL STEPS From Basic Theory to Advanced Problems of Repair, Installation, Color TV, etc.

NOW you can do ANY Radio-TV installation, service, or repair job like an expert; operate field-testing equipment; understand problems of TV broadcasting, FM-AM transmission, etc. You can step into a good-paying job—or start your own service business. And you can train yourself for your career AT HOME . . . IN YOUR SPARE TIME . . . with the McGraw-Hill Basic Course in Radio and TV.

2296 Pages—1611 Illustrations

The men who wrote this complete 4-volume course are among the outstanding radio and TV instructors in America today. They are practical, shirt-sleeved technicians. They know the questions you want answered. Every detail is clearly explained in over TWO THOUSAND PAGES of step-by-step instruction and over SIXTEEN HUNDRED "how-to-do-it" illustrations, cross-section diagrams, etc. The review questions and answers "nail down" everything you learn. At-a-glance "trouble-shooting" charts show how to diagnose instantly any radio or TV breakdown . . . and how to repair it expertly and quickly.

The course will pay for itself many times over. It can qualify a beginner for FCC's 1st-Class License test; gives an experienced technician more confidence, shows him new tricks.

Send No Money

Mail coupon below to examine this complete four-volume course FREE for 10 days; then while you use it, send small monthly installments until the price of $21.95 is paid.

These 4 books can help you qualify for FCC's New FM, TV 1st Class License Test.

ESSENTIALS OF RADIO, 800 pages, 433 illus. **BASIC TELEVISION**, 592 pages, 415 illus.
ELEMENTS OF RADIO SERVICING, 479 pages, 375 illus. **TELEVISION SERVICING**, 429 pages, 388 illus.

FREE 10 DAY TRIAL COUPON

McGRAW-HILL BOOK COMPANY, Inc.,
330 W. 42nd St., New York 36

Send me McGraw-Hill's Basic Course in Radio & TV, 4 volumes, for 10 days' examination on approval. If the books prove satisfactory, I will remit $1.95 in 10 days, and $4.00 monthly until $21.95 is paid. Otherwise I will return books postpaid.

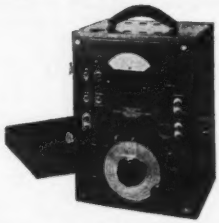
(Print)
Name .....
Address .....
City ..... Zone ..... State .....
Company .....
Position L-3-52

This offer applies to U.S. only.

INSTRUMENTS THAT BELONG IN *Your* LABORATORY

Type 310-A Z-Angle Meter — 30 to 20,000 c.p.s.

Measures impedance directly in polar coordinates as an *impedance* magnitude in ohms and *phase angle* in degrees $Z/\pm\ominus$. Measures, with equal ease, pure resistance, inductance, capacitance or complex impedances comprised of most any RLC combinations. Range: Impedance (Z), 0.5 to 100,000 ohms; Phase Angle ($\ominus$), +90° (Xt) through 0° (R) to —90° (Xc). Accuracy: Within ± 1% for impedance and ± 2° for phase angle. Price: $470.00.

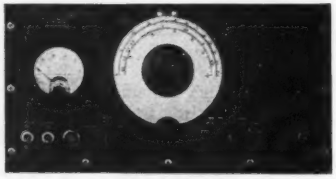


Type 311-A R-F Z-Angle Meter for radio frequencies — 100 kc to 2 mc.

Simplifies laboratory and field *impedance* and *phase angle* measurements. Ideal for checking impedance of coils, transformers, coupling networks, lines, filters, antennas, etc. Direct-reading Impedance Range: 10 to 5,000 ohms up to 200 kc, and 10 to 1,000 ohms at 1 mc. Phase Angle: +90° (Xt) through 0° (R) to —90° (Xc). Accuracy: Impedance to within ± 3%, and phase angle ± 4°. Price: $385.00.

Type 410-A R-F Oscillator — 100 kc to 10 mc. (Special models 46.5 kc to 4.65 mc available.)

Power oscillator for use as bridge driver and general laboratory measurements. Features: High stability, high output (approximate 30 volts), 50-60 Ω output impedance, expanded frequency scale, direct reading output voltmeter, compact design. Price: $385.00.



Type 320-A Phase Meter — frequency range 20 cycles to 100 kc.

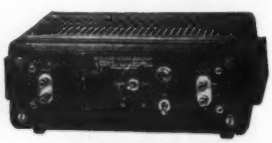
The *first* commercially available all-electronic instrument that directly measures the phase angle between two voltages *in a simple* operation. Ideally suited to applications in such fields as audio facilities, ultrasonics, servomechanisms, geophysics, vibrations, acoustics and many others.

Phase angle readings made directly without balancing . . . stable at frequencies as low as 2 to 3 cycles. Voltage range: 1 to 170 peak volts. Terminals for recorder . . . choice of relay-rack or cabinet mounting. **Price $525.00. Cabinet $25.00.**

Type 500-A Wide Band Decade Amplifier

Designed for use with the phase meter at voltage levels below one volt and as a general purpose laboratory amplifier—features high gain negligible phase shift and wide band width. Unique circuitry—which employs three cathode followers—offers wider frequency range, higher input impedance and lower output impedance than other types. Panel switch selects proper feedback compensation when either optimum amplification or phase shift operation is desired.

Outstanding specifications: *Amplification*—10; 100; 1000 selected by rotary switch . . . *Accuracy* —± 2% nominal . . . *Frequency response*—± 0.5db from 5 cycles to 2 mc on gain of 10; ± 0.5db on 5 cycles to 1.5mc on gain of 100; ± 0.8db from 5 cycles to 1mc on gain of 1000 . . . *Phase shift* —0 ± 2° from 20 cycles through 100Kc . . . *Gain stability—constant with line voltages Xc (105-125v).*



Prices: Single Type 500-A in cabinet, $205.00 (Rack mount, $200.00); Dual Type 500-AR in cabinet, $425.00.

TECHNICAL CATALOG—yours for the asking. Contains detailed information on all TIC Instruments, Potentiometers and other equipment. Get your copy without obligation—write today.

TECHNOLOGY INSTRUMENT CORP.

533 Main Street, Acton 54, Massachusetts *Tel. Acton 600*

Engineering Representatives

Cleveland, Ohio—PRospect 1-6171 Arn Prior, Ontario — Arn Prior 400 Chicago, Ill. — UPtown 8-1141 New York, N. Y.—MUrray Hill 8-6858 Rochester, N. Y.—Monroe, 2148 Cambridge, Mass.—ELiot 4-1751 Canaan, Conn.—Canaan 649 Hollywood, Cal.—HOllywood 9-6305 Dayton, Ohio—Michigan 8721 Dallas, Texas—Dixon 9918

built the model PC-3 decade scale proportional counter for clinical and production applications. It counts alpha, beta and gamma rays. Some reasons for its high precision and versatility are found in built-in automatic controls—a precision automatic preset interval timer; rapid-reset six-digit register with coincidental reset and switch; and automatic gas-purge cycle. Maximum counting rate is 1,000,000 counts per minute. High-voltage supply is 750 to 2,500 v regulated. Multiple purpose chambers accept a sample up to 2¼ in. in diameter.

Electronic Recorder

TINIUS OLSEN TESTING MACHINE Co., 1022 Easton Rd., Willow Grove, Pa. The new Model 51 electronic recorder incorporates the high-speed and accuracy inherent in the electronically controlled null balancing system which utilizes specially adapted Atcotran differential transformers built into the housing. This null system rotates the recorder chart drum in direct proportion to the strain or deformation of the specimen under test. The testing machine produces a stress coordinate by horizontal movement of the nonclog pen of the recorder. Sensitivity of the instrument is 0.05 percent of full scale for each range; accuracy of strain coordinate is ±½ division (0.2 percent of full scale); accuracy of stress coordinate is equal to that of the testing machine.

Button Capacitors

SPRAGUE ELECTRIC Co., North Adams, Mass. A new series of button ceramic capacitors for vhf and uhf applications has the tiny disk capacitor element buried in a recess in the head of a threaded fastener. They offer advantages including: minimum ground inductance of a fixed value for better uniformity, allowing higher circuit gains to be used; and a short and radially uniform bypass path to ground and lug terminals and tube socket height to provide sturdy tie points for multiple connections while maintaining short, uniform

If...

YOU CHANGE YOUR ADDRESS

Be sure to notify us at once, so future copies of ELECTRONICS will be delivered promptly.

Also make certain you have advised your local Post Master of your new address so other important mail doesn't go astray.

Both the Post Office and we will thank you for your thoughtfulness. Mail the information below to: Subscription Dept., ELECTRONICS, 330 W. 42nd St., New York 36, N. Y.

New

Name .....

Address .....

City..... Zone.... State.....

Company ..... Title.....

Old

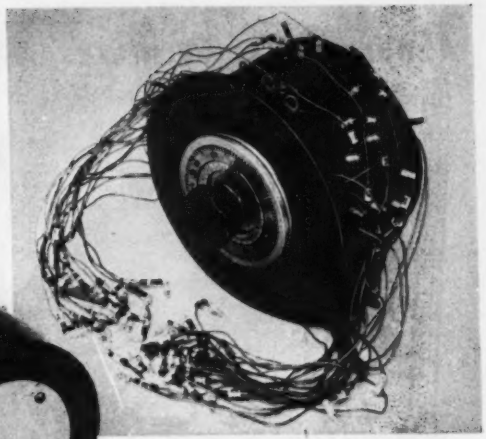
Name .....

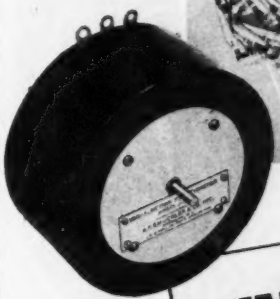
Address .....

City..... Zone.... State.....

ELECTRONICS
330 W. 42nd St.
New York 36, N. Y.

The First HAND-ADJUSTABLE Electrical Cam-





ACCURACY ± .025%

VARI-FUNCTION POTENTIOMETER MODEL J-15

Ideal for Analogue Computers, Radar, Guided Missiles, Servo Controls, Industrial applications, Laboratories, etc.

±.1% TO ±.025% FUNCTIONAL CONFORMITY

30, 45, OR 60 ADJUSTABLE TAPS

RESISTANCE VALUES FROM 10 OHMS TO 200,000 OHMS

± .5% OR BETTER TOTAL RESISTANCE TOLERANCE

2 TO 15 TURNS ROTATION

EXCELLENT RESOLUTION AT LOW RESISTANCE VALUES

DIAMETER 5⅞" DEPTH 2⅛" WEIGHT 2 LBS.

DIAL OPTIONAL

GANGING POSSIBLE

DOUBLE SHAFT EXTENSIONS

The J-15 is a functionally adjustable potentiometer. It will produce a voltage output as a desired function of shaft rotation.

The exclusive features of the J-15 and all other models of the Vari-Function Potentiometer are *unequalled accuracy* and *functional adjustability*.

Complex voltage functions may be factory set or set by the user quickly and easily to an accuracy of .025%.

The J-15 is especially suited for linear applications of utmost accuracy because it can be adjusted to compensate for inherent winding non-linearity and external loading effects.

Write, wire, or phone us if you have a problem of non-linear compensation calling for adjustability or extreme accuracy. Bulletins available on J-15 and other models.

AFSCO **A. F. SMUCKLER & CO., INC.**
Electronic and Communication Engineers and Manufacturers
202-208 TILLARY ST., BROOKLYN 1, NEW YORK

As the result of several years of investigation and research, Lord engineers have developed successful techniques for bonding silicone to metal. This extends the advantages of bonded rubber into the wider temperature range from —100° to +500°F.

A number of Lord Vibration-Control Mountings are available with silicone elastomers, and new designs are being engineered to take full advantage of the properties of this new material.

You can solve many product problems with Lord bonded-silicone parts which are used to isolate vibration and reduce operating noise, and protect parts from excessive stresses.

The easiest way to get the full story of the advantages of LORD BONDED SILICONES is to write or call . . .

BURBANK, CALIFORNIA
Joe B. Hartley
George E. Behlmer
233 South Third Street
ROckwell 9-2151
CHarleston 6-7481

CHICAGO 11, ILLINOIS
Robert T. Daily
Kenneth L. Hanson
Perry C. Goodspeed, Jr.
520 N. Michigan Ave.
Michigan 2-6010

DALLAS, TEXAS
Bruce O. Todd
1613 Tower Petroleum Building
PRospect 7996

DAYTON 2, OHIO
W. Webster Dalton
238 Lafayette Street
Michigan 8871

DETROIT 2, MICHIGAN
Everett C. Vallin
7310 Woodward Ave.
TRinity 5-8239

NEW YORK 16, NEW YORK
Vincent Ellis
Jack M. Weaver
280 Madison Avenue
MUrray Hill 5-4477

PHILADELPHIA 7, PENNSYLVANIA
George P. Harrington
725 Widener Building
LOcust 4-0147

ERIE, PENNSYLVANIA
Paul E. Dailey
Harry C. Sapper
1635 West 12th Street
2-2296

LORD MANUFACTURING COMPANY • ERIE, PA.

LORD BONDED RUBBER

HEADQUARTERS FOR
VIBRATION CONTROL MOUNTINGS
. . . BONDED RUBBER PARTS

lead lengths. The units are rated at 500 v d-c in values up to 1,000 μμf depending on characteristics. Bulletin 605 giving complete engineering details is available on letterhead request.

Sealing Compounds

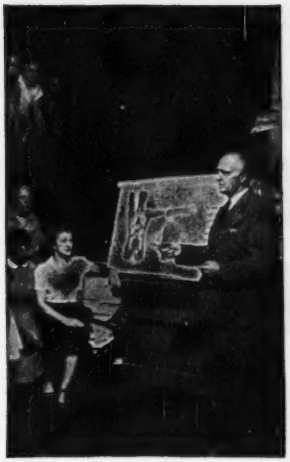
H. V. HARDMAN CO., INC., 571 Cortlandt St., Belleville, N.J. The new line of Permo potting and sealing compounds is particularly recommended for special high electrical resistance where retention of viscosity over wide temperature ranges is necessary. They have been found ideal for the casting and sealing of electronic parts, batteries, transformers, coils, capacitors and many types of electrical parts. Free samples are available from the manufacturer.

Amplifier & Recorder

EDIN CO., 207 Main St., Worcester 8, Mass., announces a new combination 8004 ink-writing galvanometer in conjunction with a compensated direct-coupled amplifier. This combination provides the user with a response of 0 to 400 cps with a tolerance ± 20 percent with records appearing directly in ink, chart speeds from 0.1 to 625 mm per second. The instrument is available in any number of channels up to 24. This amplifier and recorder combination opens a new field of application in the field of strain gage vibration, surface analysis and many other applications.

Signal Generator

COMPAGNIE GENERALE DE METROLOGIE, Chemin de la Croix-Rouge, Annecy, France. Model 917 signal generator covers from 50 kc to 50 mc in six ranges. Stability is ±0.05 percent with ±10-percent power supply voltage variation. A special feature is the seventh range of 420 to 500 kc for i-f stage alignment. Output is 1 μv to 0.1 v modulated or unmodulated r-f and 10 μv to 1 v a-f, and is taken through a calibrated attenuator system. A germanium diode eliminates meter



On the job!

Our volunteer speakers are saving thousands of lives *today* . . . in factories and business offices . . . at neighborhood and civic centers . . . at social, fraternal and service group meetings all over this land . . . by showing people what they can do to protect themselves and their families against death from cancer.

To find out what you yourself can do about cancer, or if you want us to arrange a special educational program for your neighbors, fellow-workers or friends, just telephone the American Cancer Society office nearest you or address a letter to "Cancer," care of your local Post Office. One of our volunteer or staff workers will be on the job to help you.

American Cancer Society

Phaostron

CARB-OHM

A DEPOSITED CARBON RESISTOR

HERMETICALLY SEALED

For high frequency applications, where high values of resistance are essential or power dissipations up to 2 watts are required, Hermetically Sealed CARB-OHM Resistors provide environment free performance.

Manufactured under license arrangements with Western Electric Company, Inc.

Technical information available upon application

ENVIRONMENT FREE ELECTRICAL EQUIPMENT by Phaostron

PHAOSTRON COMPANY, 151 PASADENA AVE., SO. PASADENA, CALIF., CL 6-2171

THINKING OF STAINLESS...

THINK OF
ALLMETAL
FOR THE FINEST IN
STAINLESS STEEL FASTENERS
FOR QUALITY AND DELIVERY
Complete facilities under one roof assures controlled quality and immediate delivery. Standard and "AN" specs. Specials to order.
ALLMETAL, Specialists in Stainless, Produce Stainless Products Exclusively
Write for Catalog C

MANUFACTURERS SINCE 1929

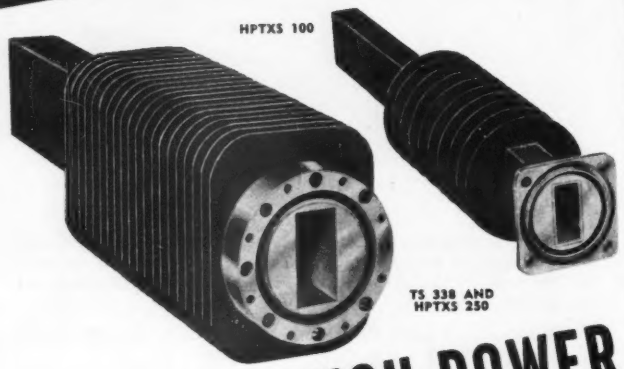
STAINLESS STEEL FASTENERS

ALLMETAL

SCREW PRODUCTS COMPANY, INC.

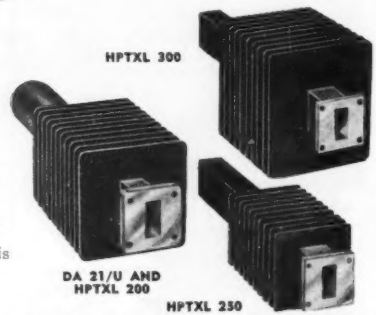
33 GREENE STREET NEW YORK 13, N. Y.

ELECTRO IMPULSE



Waveguide HIGH POWER TERMINATIONS

These waveguide loads use waveguide walls which are poor conductors. Such construction facilitates more effective removal of the heat generated in the load, and is not as subject to pulsepower breakdown (arcing) as are the designs which use filling materials in the waveguide. The lossy material consists of a mixture of Portland cement and graphite, which adequately handles the termal shock, is highly durable, and provides a highly adhesive bond to the metal waveguide walls.



Type	DA21/U	TS338	HPTXS250	HPTXL250	HPTXL200	HPTXS100	HPTXL300
Freq. Range	7-10KMC	2.4-3.7 KMC	8.2-12.4 KMC	7-10KMC	7-10KMC	8.2x12.4 KMC	7-10KMC
Waveguide	1¼"x⅝"	1.5"x3"	½"x1"	1¼"x⅝"	1¼"x⅝"	½"x1"	1¼"x⅝"
Nominal* Power Dissipation	280 Watts	1000 Watts	250 Watts	250 Watts	200 Watts	100 Watts	350 Watts
Maximum V.S.W.R.	1.15	1.1	1.15	1.15	1.15	1.15	1.15
Size	11⅝x 3½x3½	24x5⅜x 5⅜	10⅜x 3½x3½	11⅞x 3½x3½	11⅜x2¾x 2¾	9x2" diameter	11⅜x4½x 4½
Weight	6 lbs.	13 lbs.	3¼ lbs.	3¼ lbs.	2 lbs. 4 oz.	14½ oz.	5¼ lbs.
Flange	UG 51/U	UG 438/4	UG 40/U	UG 51/U	UG 138/U	UG 40/U	UG 51/U

* Without the use of water or forced air cooling.

ELECTRO IMPULSE Laboratory

62 WHITE STREET • RED BANK, N. J. • RED BANK 6-0404

electronics BUYERS' GUIDE is the ONE BOOK

THE ONLY ONE OF ITS KIND

in which design engineers and purchasing agents will find a complete, accurate, and up-to-date list of the manufacturers of all types of electronic and allied products . . . components and complete equipment.

*

Keep it handy for ready reference throughout the year.

*

When buying or requesting product information from it be sure to mention it.

zero drift. Tubes used are American miniatures 6J6 and 6X4. Any a-c power supply from 110 v to 230 v, 25 or 60 cps, may be used.

SWR & R-F Power Meters

M. C. JONES ELECTRONICS Co., 96 North Main St., Bristol, Conn., announces a new line of small, portable r-f power and swr meters. Model MM700 series Micro Match operates at power levels of 0.1 to 1,200 watts over the frequency range of 30 to 2,000 mc. The instrument weighs less than 2 pounds and requires no external source of power. It is designed for use in making laboratory measurements and for monitoring both transmitter and antenna performance in the field.

Literature

Diffusion Pumps. Distillation Products Industries, Rochester 3, N.Y. A new data sheet describes and charts the characteristics of type MCF diffusion pumps. It points out that this series of all-metal fractionating pumps is recommended for evacuation of large electronic tubes, particle accelerators and other devices requiring an ultimate pressure of less than 10^{-6} mm Hg. The pumps described range in size from a 2-in. diameter model suitable for exhaust of c-r tubes to pumps several feet in diameter used on giant synchrocyclotrons and linear accelerators.

Insulating Materials. General Electric Co., Pittsfield, Mass. Bulletin CD1-35 describes the company's various types of electrical insulating materials. Properties and applications of varnishes, Glyptal alkyd resin insulating finishes, varnished cloths and tapes, sealing and filling compounds, and silicone insulating materials are given, with accompanying photographs.

Color-Code Chart. Centralab Division of Globe-Union Inc., Milwaukee, Wisc. Printed in eleven colors

TRANSICOIL

"tailored" production means servo control motors that are fitted to your needs *exactly!*

Write for Bulletin M

CONTROL MOTORS · PRECISION GEAR TRAINS
INDUCTION GENERATORS · SERVO AMPLIFIERS

TRANSICOIL CORPORATION
107 GRAND STREET, NEW YORK 13, N.Y.
See Us at the I.R.E. Show—Booth 229

HIGH STABILITY *with this NEW* miniature voltage reference tube

TUBE DATA

Preferred quiescent current	6 mA
Nominal operating voltage	85 V
Operating current range	1 to 10 mA
Max. A.C. resistance	450 Ω
Base	Small Button Miniature 7-pin

Here's another first by Mullard. A miniature, high stability voltage reference tube, type 85A2, designed for compact industrial and scientific equipments.
Working in a constant current circuit, the 85A2 will replace a standard cell as a built-in source of voltage reference. It forms the ideal reference against which to compare the level of almost any physical quantity which is convertible into an e.m.f.
For full details of this and other tubes in the Mullard range of voltage reference and stabilizing tubes, write today to:-

In U.S.A.—International Electronics Corp., 137 Hudson St., N.Y., 13, N.Y.
ELSEWHERE—The Local Mullard Representative.

NOTE THESE EXCLUSIVE FEATURES

SHORT TERM STABILITY	For 100 hour periods, a conditioned tube is stable to within 0.1% voltage variation, in spite of intermittent switching.
LONG TERM STABILITY	Voltage variation of a conditioned tube over life is less than 0.2%.
TEMPERATURE COEFFICIENT	Less than 2.7mV/°C. No temperature compensation is necessary in most applications.
WARMING UP PERIOD	Three minutes for specified performance.

Mullard Ltd

Makers of the Image Converter, the world's fastest photographic device

MULLARD OVERSEAS LTD., SHAFTESBURY AVENUE, LONDON, ENGLAND
EXPORTERS OF THE PRODUCTS OF MULLARD LTD.

MEV3

with over 3,300 color dots or marks, the new color-code chart will be found useful by electronic engineers, in research and educational laboratories, by purchasing and production men, by radio and tv service engineers, and by distributors of electronic equipment. Color coding outlined on the chart includes that of transformers, battery cables, antennas and ground leads, telephone switchboard cable, RTMA and JAN mica, paper and ceramic capacitor values, standard values of fixed composition resistors, miscellaneous capacitors and resistors, electrodynamic speakers, and radio and tv chassis. The chart is 36 in. high × 30 in. wide.

Machine Screws. The Progressive Mfg. Co., Torrington, Conn. Catalog No. 19 is a 16-page treatment of a line of machine screws and specialties. Types of screw heads and methods of measurement are illustrated. Tables show different types with diameters and threads per inch. Machine screw-nut thread dimensions and standard weights are included.

Servo Amplifier Data. Servomechanisms Inc., Post & Stewart Avenues, Westbury, N.Y., has released two data folders on the SA104H and SA112H servo amplifiers. Both units described are miniaturized, hermetically-sealed, plug-in electronic amplifiers designed to control a 400-cycle, two-phase motor. Complete technical descriptions, block diagrams and application information are included.

Regulated D-C Power Sources. Sorensen & Co., Inc., 375 Fairfield Ave., Stamford, Conn. A new catalog giving full descriptions and up-to-the-minute ratings and specifications of the entire line of standard Nobatrons (electronically regulated d-c power sources) is now available. Also included in the catalog is a comprehensive discussion of circuit theory and a description, with diagrams, of some of the many ways in which Nobatrons can be used.

TV Antenna Catalog. The La-Pointe Plascomold Corp., Windsor Locks, Conn. A Spanish edition

PHYSICISTS
And
SENIOR RESEARCH ENGINEERS

• • •

POSITIONS NOW OPEN

• • •

Senior Engineers and Physicists having outstanding academic background and experience in the fields of:

- Microwave Techniques
- Moving Target Indication
- Servomechanisms
- Applied Physics
- Gyroscopic Equipment
- Optical Equipment
- Computers
- Pulse Techniques
- Radar
- Fire Control
- Circuit Analysis
- Autopilot Design
- Applied Mathematics
- Electronic Subminiaturization
- Instrument Design
- Automatic Production Equipment
- Test Equipment
- Electronic Design
- Flight Test Instrumentation

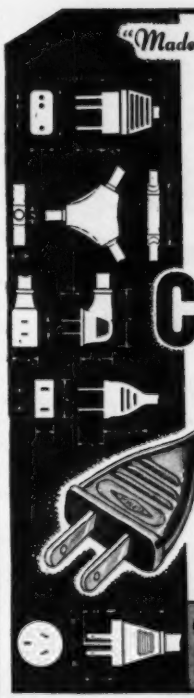
are offered excellent working conditions and opportunities for advancement in our Aerophysics Laboratory. Salaries are commensurate with ability, experience and background. Send information as to age, education, experience and work preference to:

NORTH AMERICAN AVIATION, INC.
Aerophysics Laboratory
Box No. K-4, 12214 S. Lakewood Blvd.
DOWNEY, CALIFORNIA

"Made by Engineers for Engineers"

CORNISH

custom CORD SETS



Available in rubber, neoprene and plastic

Tailored to your needs . . . quality controlled from start to finish . . . deadly enemies of CORDelirium! You make the electronic products and we will supply the dependable connecting parts.

Also
"NOFLAME-COR"
The Television Hookup Wire

CORNISH WIRE CO., INC.
50 Church Street. New York 7, N. Y.

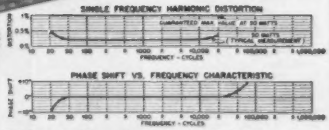
Comparison proves—

McIntosh

WORLD'S FINEST AMPLIFIER!

50W-2 Amplifier
50 Watts (Peak 100)

- Less than 1% harmonic or intermodulation distortion even at peak power—reproducing the entire audible range from 20-20,000 cps.



Compare McIntosh 50W-2 with any amplifier—at any price. For it is only by such comparison that you can fully appreciate the truly superior qualities of this unique, patented instrument that has reached the theoretical limit of quality and efficiency! No other amplifier can give you so much power with so little distortion, at such low cost.

Write today for technical information and name of nearest dealer.

AE-2A Amplifier Equalizer

McINTOSH LABORATORY, INC.
323 Water St., Binghamton, N. Y.

IN STOCK
AT RADIO SHACK —
AMPEX
MODEL 400A

- *Full Remote Control!*
- *Push Button Operation!*
- *Takes NARTB, RMA Reels!*
- *Dual 7½" and 15" Speeds!*
- *Half or Full Track!*
- *Instantaneous Monitoring!*

RADIO SHACK CORP.
IS THE DIRECT FACTORY SALES REPRESENTATIVE FOR
ALL AMPEX PRODUCTS
IN NEW ENGLAND AND UPPER NEW YORK STATE

15,000 CPS RESPONSE ± 4 DB AT 7½" PER. SEC. ON HALF-TRACK!

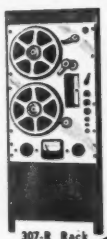
Available NOW, directly from Radio Shack stock, the brilliant new Ampex 400-A magnetic tape recorder whose response and characteristics are the sensation of the electronic world. Other features include: Flutter and Wow — 15 ips, well under 0.2% rms measuring all flutter components from 0-300 cycles using 3000 cycle tone (7.5 ips, under 0.25%). Signal-to-Noise Ratio — over 55 db at both 7.5 and 15" as defined by NARTB standards. Playback Timing Accuracy — 3.6 sec. in 30 min. program, 0.2%.

Model 400-A, portable, halftrack	$985.00
Model 401-A, portable, full track	985.00
Descriptive bulletin A-211	FREE
*4800 ft. reel of tape on NAB hub	14.38
*2400 ft. reel on NAB hub	7.19
*2400 ft. on NAB aluminum reel	9.05

*"Scotch" Type 111A. Quantity discount!

AMPEX DATA RECORDERS!

Whatever your industrial, military or laboratory requirements for data recorders, Radio Shack is equipped to fill them — from the standpoint of both delivery and engineering service. Some Ampex recorders, such as the Ampex 307 telemetering recorder (shown at right) are carried in stock in Boston. Others are built at Ampex on order from us, including units for: shock and vibration recording; multi-track up to 26 channels; noise analysis; data storage for electronic computation.

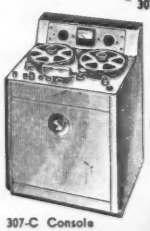


307-R Rack

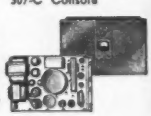
307-S Portable

OUR ENGINEERING SERVICES ARE FREE!

Let Radio Shack's AMPEX-FACTORY-TRAINED personnel help you in the planning and design of the Ampex recording equipment you need for industrial and scientific use. In addition, broadcast and sound engineers are invited to discuss their Ampex needs with our technical staff — regarded by manufacturers and users alike as one of the most competent in this country. Write, wire or telephone LA 3-3700 in Boston for information and service entirely without obligation.



307-C Console



Capstan Motor Amplifier

FREE!

Radio Shack 1952 industrial electronic parts catalog: 192 pages listing over 15,000 JAN and standard components with reference data!

RADIO SHACK
CORPORATION
167 Washington St., Boston 8, Mass.

of the Vee-D-X catalog entitled "La Linea de Antenas de Television mas completa y Potente del mundo" was recently issued. Designed for distribution in Mexico, Cuba and South America, the catalog includes illustrations and complete information on practically all Vee-D-X products.

Grounding Sheath Connectors. The Thomas & Betts Co., Inc., 66 Butler St., Elizabeth, N.J. Data sheet S5 contains complete technical information on a new grounding sheath connector—a two-piece compression-type connector made for terminating and grounding braided shields on wire and cable used in radar, critical radio and a-f circuits and for uhf work, for any electronics use requiring shielded conductors. Manual and power tools and method of installation are fully covered.

Motor Generator Sets. Bogue Electric Mfg. Co., 52 Iowa Ave., Paterson 3, N.J. Bulletin 440 describing a complete line of 400-cycle motor generator sets with extremely good waveform output and with very low percentage of harmonics is now available. The motor generator sets described are widely used in laboratories and factories and in industrial operations for testing electronic equipment and operating h-f motors, marine and aircraft power supplies, high-speed machine tools and radar equipment.

H-F Insulators. American Lava Corp., Chattanooga 5, Tenn., has issued the useful new bulletin 512 giving JAN-1-8 numbers cross indexed with its own numbers on Alsimag high-frequency insulators. It will be especially helpful to any design engineer, estimator or purchasing agent dealing with electrical or electronic equipment for the armed services. The insulators are illustrated and line drawings and dimensions are shown. Mechanical and electrical properties of the materials are given in detail.

Breaker-Type D-C Amplifier. Liston-Becker Instrument Co., Inc., 20 Beckley Ave., Stamford, Conn., has issued a brochure dealing with the model 14 ultrasensitive breaker-

Time to move in on the NUCLEAR ENERGY FIELD

"Ground Floor" Space Available to Alert Manufacturers

Everybody talks about the weather, but until the "rain makers" no one did anything about it. One can almost say the same about the nuclear energy field. Everybody talks about how big its potentials are, but only a comparatively few manufacturers are doing anything about it.

The industry is young – practically starting and there's still time for alert manufacturers to get in on the ground floor. A start now will provide that available ground floor position – one that will prove of inestimable value in the future. An established name, plus a proven product, will be the mainstays when the industry reaches its expected expansion.

If an established and recognized position in the field is half as important as manufacturers believe, it is doubly true today in the nuclear field. The alert manufacturer can move in now and take his position up front.

It's BIG today—Bigger tomorrow

Yes, nuclear energy is a big field – 7 billion dollars' big. But there are two other important things. It promises to be bigger and it will be wider in scope and application. The future also foresees general industry taking over more and more the practical development of the scientific, power and medical applications. Therein lie the plus profits of tomorrow.

If your products fall within any of the basic classifications that follow...

Air Cleaners	Ceramics	Motors
Amplifiers	Chronographs	Ovens
Analyzers	Containers	Phosphors
Balances	Controls	Plastics
Bearings	Detectors	Power Supplies
Bellows	Electron Tubes	Pyrometers
Blowers	Gages	Resistors
Bridges	Generaters	Shielding
Burners	G-M Apparatus	Test Chambers
Bushings	Insulators	Testers
Cameras	Ionization Chambers	Tile
Capacitors	Metals	Timers
Carboys	Mixers	Transformers
Centrifuges	Monitors	X-Ray

to mention only a few

***Then* you can sell it most effectively in the nuclear field through...**

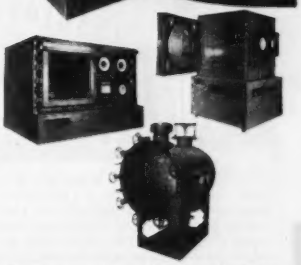
For further information on the scope of the nuclear market, consult any NUCLEONICS representative for additional data. Complete data on the new enlarged NUCLEONICS is also available from him or write direct to our New York office.

NUCLEONICS

A McGraw-Hill Publication

330 W. 42nd St. N. Y. 36, N. Y.

now a COMPLETE TYPE TESTING LABORATORY *from* ONE *source*



Bowser is the only manufacturer today who can provide a COMPLETE line of type testing equipment, custom engineered to individual requirements. Bowser environmental simulation units meet all MIL, JAN, USAF, AN and other Government specifications for testing equipment.

In addition to a complete range of standard models, Bowser can provide special equipment, with special accessories if necessary, to meet individual requirements of temperature, humidity, altitude, sand and dust etc. Bowser's Engineering staff invites you to take advantage of their long continuous experience, the most versatile in the field.

✓ CHECK AND MAIL TODAY

BOWSER TECH. REFRIG., Terryville, Conn.

Send information on test equipment checked:

- ☐ High Temperature
- ☐ Low Temperature
- ☐ Temperature Shock
- ☐ Humidity
- ☐ Altitude
- ☐ Walk-In Rooms
- ☐ Fungus Resistance
- ☐ Rain and Sunshine
- ☐ Sand and Dust
- ☐ Immersion
- ☐ Explosion Proof
- ☐ Vapor Tight
- ☐ Special Engineering

Name_____ Post_____

Company_____

Street_____

City_____ Zone____ State_____ 3-4

BOWSER

TECHNICAL REFRIGERATION

DIVISION BOWSER INC.

TERRYVILLE • CONN.

NOW!

Tensolite

MINIATURE and SUB-MINIATURE

WIRE & CABLE

INSULATED WITH TEFLON®

-for high-temp applications!

TENSOLON Hook-up Wires and Multiple Conductors are now available in sizes from AWG 30 through 22. They can be supplied with or without wire-braid shields. TENSOLON wire and cable constructions offer outstanding advantage in many respects. Resistance to heat is extremely high and flexibility is excellent, the insulation is tough, offers maximum mechanical protection and is completely moisture-proof. Dielectric strength is very high. TENSOLON is the only wire with TENSULATED DU PONT TEFLON insulation.

Tensolite VINYL PRODUCTS

Stranded Sizes from AWG 40 to 20

CLASS A Hook-up Wire

CLASS B Shielded Lead Wire

CLASS C Textile-Braid-Covered Lead Wire

CLASS D Textile-Braid-Covered, Shielded Lead Wire

CLASS E Twisted (multi-conductor) Cable

CLASS F Shielded, Twisted (multi-conductor) Cable

CLASS G Textile-Braid-Covered, Twisted (multi-conductor) Cable

CLASS H Textile-Braid-Covered, Shielded, Twisted (multi-conductor) Cable

CLASS I Shielded, Parallel (multi-conductor) Cable

CLASS J Textile-Braid-Covered, Parallel (multi-conductor) Cable

CLASS K Textile-Braid-Covered, Shielded, Parallel (multi-conductor) Cable

Tensolite CUSTOM CONSTRUCTIONS

Constructions to customer specifications

CLASS L — Special wires and cables to customers specifications can be supplied promptly at reasonable cost. Submit your specifications for quote.

Special wire and cable assemblies (units)

CLASS U — Tensolite service includes wire and cable assemblies cut to length, stripped, tinned, pigtailed, etc. — to specifications. Send sketch for quote.

See us at the IRE SHOW BOOTH 426

WRITE FOR SAMPLES AND CATALOG!

Tensolite produces a virtually unlimited variety of miniature wire and cable. Service is prompt, efficient and economical. Write for free samples and complete catalog today, on your company letterhead.

Tensolite INSULATED WIRE COMPANY

INCORPORATED • TARRYTOWN, NEW YORK

type d-c amplifier. The amplifier described, having very high zero-stability and very low noise-level, is being used extensively for the replacement of suspension-type galvanometers and for recording or controlling operations involving measurements in the microvolt and fractional microvolt regions.

Precision Instrument Parts. Instrument Components, Inc., 181 Lawrence St., New Hyde Park, N.Y., has available a catalog covering Belock precision instrument parts. The parts described are electromechanical subassemblies, and include mechanical and electrical limit stops, precision gearing, differentials in two sizes, high speed magnetic clutches, mounting brackets and grid plates. The catalog should prove of interest to engineers, developers and producers in the field of servos and automatic controls as well as in the field of analog computers.

Industrial Instruments. Minneapolis-Honeywell Regulator Co., Brown Instruments Division, Wayne and Windrim Aves., Philadelphia 44, Pa. Catalog No. 5000, consisting of 28 pages, describes the principal instruments, control devices and related components manufactured by the company. Specifications of approximately 100 measuring and control instruments and valves are outlined. Included are several new designs including the differential controller and Tel-O-Set controller family.

Electrometer Shunt. Keithley Instruments, 3868 Carnegie Ave., Cleveland 15, Ohio, has released a 2-page bulletin on its model 2001 electrometer shunt that permits quick conversion of the company's model 200 electrometer to a micro-microammeter. The bulletin lists specifications, and includes connection diagrams for numerous exacting measurements of current, such as insulation leakage in ion chambers and photoelectric cells.

Flexible Shafts. S.S. White Industrial Division, 10 E. 40th St., New York 16, N.Y., has announced publication of the third edition of its flexible shaft handbook. The 256-

HUGHES

Research and Development Laboratories

Invites inquiries from Engineers and Physicists

Culver City, California

ASSURANCE IS REQUIRED THAT RE-LOCATION OF THE APPLICANT WILL NOT CAUSE DISRUPTION OF AN URGENT MILITARY PROJECT.

HEAT RESISTANT WIRES FOR EVERY APPLICATION . . .

Many research projects require the application of heat to irregular shapes of special equipment. Insulated resistance wire provides a flexible unit which may be the answer you are looking for.

Tell us about your heating problem maybe we can help.

- HEATING UNITS
- HEATING ELEMENT
- RESISTANCE LINE CORD
- THERMOCOUPLE WIRE
- ASBESTOS LEAD & FIXTURE WIRE
- INSULATED RESISTANCE WIRE
- FIBERGLAS INSULATED WIRE
- WIRE TO ANY SPECIFICATIONS

Send your electronic control, communications or appliance wiring specifications for a recommended solution by our engineers.

FOR A TRIAL ORDER OR A CARLOAD *consult*

THE LEWIS ENGINEERING CO.

Wire Division

NAUGATUCK CONNECTICUT

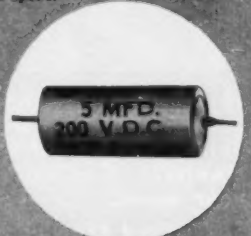
VACUUM FILLED OIL IMPREGNATED

CHICAGO APPROVED

CAPACITORS

Approved SILICONE BUSHING capacitor, oil impregnated, hermetically sealed. Featuring SILICONE BUSHINGS for peak performance at high temperature operation.

Approved SILICONE BUSHING RECTANGULAR TYPE capacitor, oil impregnated, hermetically sealed and tested at twice rated voltage to meet all spec's.



Approved GLASS SEALED TUBULAR TYPE capacitor, oil impregnated, hermetically sealed to meet all spec's.

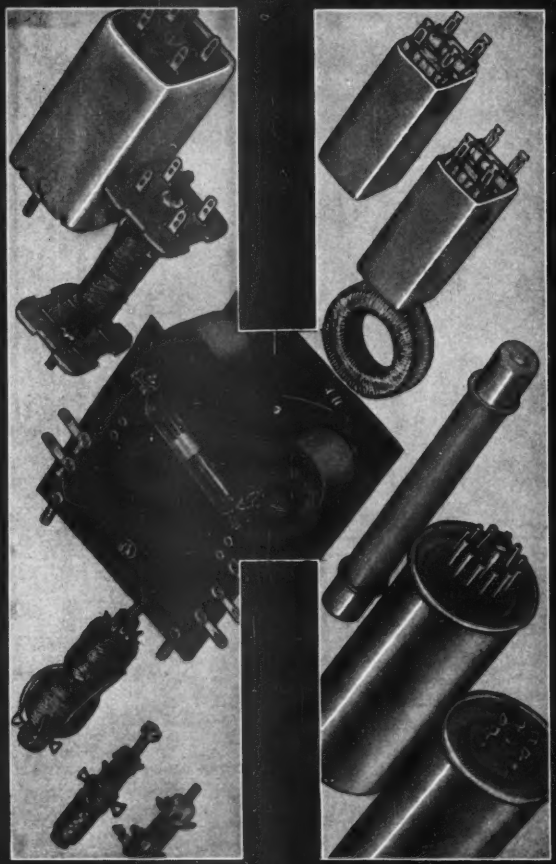
CHICAGO CONDENSER CORPORATION

3255 WEST ARMITAGE AVE.
CHICAGO 47, ILLINOIS

RADIO FREQUENCY COILS

DELAY LINES TOROIDAL COILS

HERMETIC SEALING FACILITIES



If your problem concerns research, design, development — long or short production runs — exacting commercial or military specifications — HARNETT ELECTRIC CORPORATION can fulfil your needs.

Specialized knowledge, skill and a full range of facilities has enabled HARNETT ELECTRIC CORPORATION to produce superior products of consistent dependability for your most precise need.

HARNETT ELECTRIC CORPORATION

138 Haven Ave., Port Washington, Long Island, N. Y.

Telephone: Port Washington 7-3334

page reference manual provides a comprehensive and authoritative picture of the range and scope of flexible shafts in transmitting power and remote control and gives full details on their construction, selection and application. The current edition covers changes and developments that have been made in the flexible shaft field since 1944. An appendix of engineering tables and data adds to the value of the handbook as an essential part of any engineering library. Copies of the handbook are being offered to designers, engineers and purchasing agents who write for a copy on their company letterhead.

Beam Pentode. Lewis and Kaufman, Inc., Los Gatos, Calif., has available a technical data sheet describing the type 4E27 beam pentode. The tube is illustrated and described with dimensions, operating curves and electrical details. Figures for typical operation and maximum ratings are given for the tube in service as a class-C r-f power amplifier and oscillator, a class-C r-f doubler amplifier, and a class-A a-f amplifier and modulator.

Static Magnetic Memory. Wang Laboratories, 296 Columbus Ave., Boston 16, Mass., has published a pamphlet on its static magnetic memory, a radically new number storage device. Chief applications and full technical data concerning the unit are given.

Pickups. Consolidated Engineering Corp., 300 N. Sierra Madre Villa, Pasadena 8, Calif. Pickups and how to choose them—the answers to critical application questions regarding amplitude and accelerations; frequencies; nature of motion and range of temperature are contained in technical bulletin 1503. The pickups described are widely used as primary sensing units in vibration and acceleration studies. Attached to the machines or structures under test, the pickups discussed convert the motion to a varying, proportional voltage which may then be read on vibration meters, in terms of amplitude and frequency; viewed

Want to know about the . . .

Augetron
Eccles-Jordan Circuit
Kathetron Tube
Mekapion Tube
Permatron
Petoscope
Schlieren Method
Scophony
Semagraph
Sirufer
Syndec
Theremin
Tratonium
Voder

or other early electronic developments?

☆

You can find out about them in the early issues of ELECTRONICS

☆

The cumulative index to ELECTRONICS' first decade, pages C-1 to C-36 in the 1951-1952 electronics BUYERS' GUIDE tell you where to look

hermetically sealed

actual size

miniature and sub-miniature

audio transformers

- **MANUFACTURED** to meet most exacting MIL-T-27 specifications.
- **GLYPTOL** impregnation prior to potting assures quiet operation and long life under all adverse conditions.
- **MU-METAL** core assures a light weight, compact unit with full efficiency and wide frequency response.
- **MIL FAMILY TYPE AVAILABLE:** Input—10, 11; Driver—12; Output—13; Modulation—14; Interstage—15; Matching—16, 17; Audio Oscillator—18; Multi-Purpose—19; Audio Inductor—20.
- **PRODUCTION SAMPLES:** Submitted for your inspection and approval.
- **SENSIBLE DELIVERY:** Send your B/P specifications for quotations and delivery schedule.
- **JOBBER LINE:** Immediate delivery on full line of ouncer and subouncer type miniatures.

CREST
LABORATORIES, INC.
Whitehall Building, Far Rockaway, N. Y. • FA 7-2732

NEW WELCH VACUUM PUMP offers you Faster Pumping — Larger Capacity

HIGH CAPACITY
5 cubic feet per minute (140 liters per minute)

GUARANTEED VACUUM
0.0001 mm Hg. or 0.1 microns

QUIET OPERATION
VISIBLE OIL LEVEL
COMPACT DESIGN
Overall dimension for pump and motor 15½" high and 11" wide x 19¾" long

This new two-stage Duo-Seal pump is constructed with the same care and precision as its fore-runners in the Duo-Seal line. The extremely quiet operation, so much appreciated in the other models, is also characteristic of this unit.
A positive oil seal prevents the oil from backing into the exhaust line. Oil may be changed in a few minutes due to the conveniently located oil drain.

No. 1402 B

1402. DUO-SEAL TWO-STAGE VACUUM PUMP. Pump unit only, not mounted on a base, but with a 10 inch grooved pulley, a supply of oil, and directions for use. *Each* **$190.00**

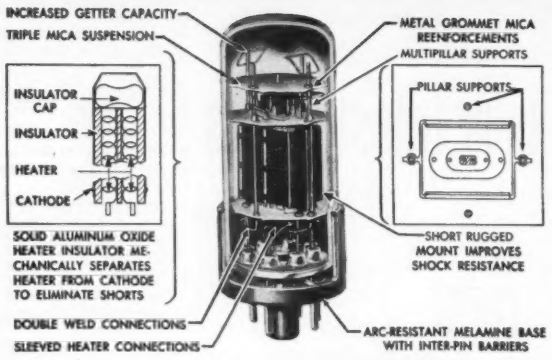
1402B. DUO-SEAL* PUMP, MOTOR-DRIVEN. A No. 1402 Pump mounted on a base with a ½ H.P. 115-volt A.C. motor. Complete with pulleys, belt, and cord. *Each* **$250.00**
*Reg. U. S. Pat. Off.

W. M. WELCH SCIENTIFIC COMPANY
Established 1880
1515 SEDGWICK STREET, Dept. H, CHICAGO 10, ILLINOIS, U. S. A.

BEAM POWER AMPLIFIER

ANOTHER RELIABLE ELECTRON TUBE RUGGEDIZED BY

ECLIPSE-PIONEER



● We are not in the standard vacuum tube business, but we are in the business of developing and manufacturing a reliable line of special purpose electron tubes—tubes that will serve and meet the stiff and varied operational requirements of aviation, ordnance, marine and other fields of modern industry. Typical of these are receiving type tubes such as Full-Wave Rectifiers, R-F Pentodes, Twin Triodes, and the Beam Power Amplifiers illustrated above and described below. All of these tubes are exhausted on a special automatic exhausting machine capable of extra high evacuation, and are aged under full operating and vibration conditions for a period of 50 hours. In addition to the tubes described above, Eclipse-Pioneer also manufactures special purpose tubes in the following categories: gas-filled control tubes, Klystron tubes, spark gaps, temperature tubes and voltage regulator tubes.

LOOK FOR THE PIONEER MARK OF QUALITY
REG. U. S. PAT. OFF.

RATINGS

Heater voltage—(A-C or D-C)	6.3 volts
Heater current	0.6 amps
Plate voltage—(max.)	300 volts
Screen voltage—(max.)	275 volts
Plate dissipation—(max.)	10 watts
Screen dissipation—(max.)	2 watts
Max. heater-cathode voltage	300 volts
Max. grid resistance	0.1 megohms
Warm-up time	45 sec.

(Plate and heater voltage may be applied simultaneously)

TYPICAL OPERATION

Single-Tube, Class A_1 Amplifier

Plate voltage	250 volts
Screen voltage	250 volts
Grid voltage	−12.5 volts
Peak A-F grid voltage	12.5 volts
Zero signal plate current	45 ma
Max. signal plate current	47 ma
Zero signal screen current	4.5 ma
Max. signal screen current	7.0 ma
Plate resistance	45,000 ohms
Transconductance	4,000 μmhos
Load resistance	5,000 ohms
Total harmonic distortion	8%
Max. signal power output	4.0 watts

PHYSICAL CHARACTERISTICS

Base	Intermediate shell octal 8-pin
Bulb	T-9
Max. overall length	3¼ in.
Max. seated height	2⅝ in.

Other E-P precision components for servo mechanism and computing equipment:

Synchros • Servo motors and systems • rate generators • gyros • stabilization equipment • turbine power supplies and remote indicating-transmitting systems.

For detailed information, write to Dept. O

ECLIPSE-PIONEER DIVISION of Bendix AVIATION CORPORATION

TETERBORO, NEW JERSEY

Export Sales: Bendix International Division, 72 Fifth Avenue, New York 11, N. Y.

on an oscillograph screen, or recorded permanently by a multichannel recording oscillograph.

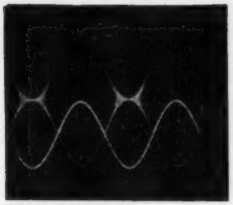
Voltage Regulator. C. J. Applegate & Co., 1816 Grove St., Boulder, Col. A single-sheet bulletin covers the model 112 d-c voltage regulator that is designed to deliver extremely well regulated and filtered power from an unregulated d-c source. The unit described, a complete self-contained type requiring only a power source, will control as much as 200 ma. Complete technical specifications are included.

Mobile Radio Equipment. Link Radio Corp., 125 W. 17th St., New York 11, N.Y. Three recent bulletins cover the Expediter line of adjacent-channel equipment for operation in the 25 to 50-mc range. The type 2750-30DR-A1 affords 30 watts r-f output; type 2750-60DR-A1 gives 60 watts r-f output; and type 2750-10VR-A1 affords 10 watts r-f output. Principal characteristics and specifications for each are given.

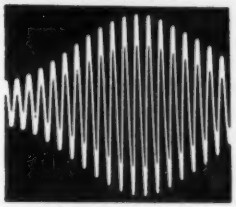
Plastic Coatings. Juel Corp., 333 N. Santa Anita Ave., Arcadia, Calif. A recent bulletin discusses the many advantages of encapsulation of components in protective plastic encasements. The castings described are available in a wide variety of types, from extremely flexible to very brittle. The company's complete facilities for encapsulating, imbedding and laminating are shown.

Flexible Shafting. F. W. Stewart Mfg. Corp., 4311 Ravenswood Ave., Chicago 13, Ill., has issued a 64-page book on flexible shafting. It shows with graphic illustrations many applications in a wide variety of industries. The advantage of flexible shafting and method of application are fully described. There are also illustrated many types of end fittings, casings, adapters and shaft combinations that apply to the variety of standard sizes and types of shafts available.

Porcelain Specialties. Star Porcelain Co., Muirhead Ave., Trenton, N.J., has released a 24-page brochure giving a complete descrip-



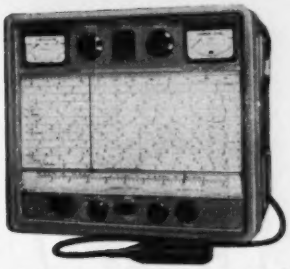
320 kc modulated 400 cps; audio on second beam.



24 kc modulated 60% 1 kc.

We shall be pleased to see you at the
I. R. E. CONVENTION
BOOTH 137

100% MODULATION....



...A.M. WITHOUT F.M.

Excellent amplitude modulation is a feature of the Standard Signal Generator TF 867—a.m. accompanied by minimum spurious f.m.—less than 100 cps below 5 mc, 1,000 cps above. Other features are:

Wide range—15 kc (or less) to 30 mc in 11 bands on full vision scale. **Crystal accuracy**—0.01% 1 mc harmonic source built-in. **Easy tuning**—discrimination 1 part in 10,000 on total 15 ft. scale length. **High output**—4 volts down to 0.4 microvolts. Flexible modulation—internal 400 and 1,000 cps, 0-100%, external 50-10,000 cps ± 2db.

MARCONI INSTRUMENTS 23-25 Beaver Street, New York

CANADA: CANADIAN MARCONI CO., MARCONI BUILDING, 2442 TRENTON AVENUE, MONTREAL
ENGLAND: MARCONI INSTRUMENTS LIMITED ST. ALBANS, HERTS.

SEALING
DIPPING
POTTING
IMPREGNATING

INSULATING
FUNGUSPROOFING
MOISTUREPROOFING
HEAT CONDUCTING

WAXES BIWAX COMPOUNDS

Developed and produced for manufacturers of electronic components and other electrical units.

Specifications and samples available on request.

Information relative to your problem or application will enable us to make suggestions and recommendations.

BIWAX CORPORATION 3445 HOWARD STREET SKOKIE, ILLINOIS

Quartz Crystals

Made to your specific specifications. Accurate to the minutest tolerance. Exacting in performance—with thorough dependability.

Whether one or a million, you get prompt shipment. Made by craftsmen with a quarter century experience.

Send us detailed description and quantity for prices.

MICHAEL STAHL, Inc.
215 Fulton Street New York 7, N. Y.

Can YOU measure up at BOEING?

IF YOU CAN, there's a rewarding, long-range career for you here, in an Engineering Division that's been growing steadily for 35 years.

As a Boeing engineer, you'll share the prestige of Boeing leadership. You'll have at your disposal the finest research facilities in the industry, and you'll be working with engineers who have blazed exciting new trails in every phase of aviation.

There are excellent opportunities, right now, for experienced and junior engineers for aircraft

- **DESIGN**
- **DEVELOPMENT**
- **RESEARCH**
- **PRODUCTION**

also for servo-mechanism and electronics designers and analysts and for physicists and mathematicians with advanced degrees.

Boeing offers you work on such vital projects as the security-shrouded B-52, on the six-jet B-47, and on guided missiles and other revolutionary programs.

Openings are available at both Seattle and Wichita. Your choice of location—Pacific Northwest or the Midwest. You'll enjoy a good salary that grows with you, and Boeing provides a generous moving and travel expense allowance.

You'll be proud to say, "I'm a *Boeing* engineer!"

WRITE TODAY TO THE ADDRESS BELOW OR USE THE CONVENIENT COUPON

JOHN C. SANDERS, Staff Engineer—Personnel
DEPT. H-3
Boeing Airplane Company, Seattle 14, Wash.

Engineering opportunities at Boeing interest me. Please send me further information.

Name _____

Address _____

City and State _____

NO OTHER SOURCE CAN MATCH
RAYTHEON'S Complete Facilities
for Designing and Producing

TOROIDS

Over 10 Years' Experience in Designing and Building Toroid-L Units

TOROID-L-COILS

Designed from the problem up, or wound to specified C, L and Q values. Precision wound on temperature stabilized, powdered permalloy cores, high permeability solid materials or stamped "O" cores. Able to wind #20 to #42 wires on "wedding ring" cores to small ultimate I.D. Facilities for all types of winding, including square coils wound from strip materials for improved geometry.

TRANSFORMERS

Multiple wound and tapped . . cased or uncased . . . for all commercial and military applications.

FILTER NETWORKS

Complete networks for audio or ultra-sonic work.

LITZ-WOUND TOROIDS

One of the very few sources equipped for litzendraht coil windings.

LUMPED PARAMETER DELAY LINES

For time-measuring applications.

MAGNETIC AMPLIFIER COILS

For complete servomechanism and other magnetic amplifiers.

RAYTHEON
Excellence in Electronics

OTHER RAYTHEON PRODUCTS INCLUDE:

MARINERS PATHFINDER® radar; Submarine Signal FATHOMETERS®; Marine radiotelephones; WELDPOWER® welders; Voltage stabilizers (regulators); Transformers; RectiCharger® battery chargers; RectiFilter® battery eliminators; Sonic oscillators for laboratory research; Standard control knobs; Electronic calculators and computers; Television receivers; Radio, television, subminiature and special purpose tubes; MICROTHERM® diathermy and other electronic equipment.

®Reg. U. S. Pat. Off.

Raytheon welcomes inquiries from manufacturers and design engineers for specific information. Immediate attention given to all problems submitted. Complete facilities for engineering design and production of models as well as large volume production.

RAYTHEON
MANUFACTURING COMPANY
EQUIPMENT SALES DIVISION
DEPT. 6470-A, WALTHAM 54, MASSACHUSETTS

DISTRICT OFFICES: BOSTON, NEW YORK, CLEVELAND, CHICAGO, NEW ORLEANS, LOS ANGELES (WILMINGTON), SAN FRANCISCO, SEATTLE
INTERNATIONAL DIVISION: 19 RECTOR STREET, NEW YORK CITY

tion of various ceramic bodies that are used principally in the manufacture of electrical and electronic equipment. It contains suggestions for good ceramic design as well as tables giving complete data on physical properties and application information. There is also a section picturing and describing the research, engineering and production facilities as well as the steps taken to control the quality of the company's custom-made porcelain specialties.

Hermetically-Sealed Thermostats. Stevens Mfg. Co., Inc., 69 South Walnut St., Mansfield, Ohio, has announced an illustrated bulletin on its neoprene-protected bimetal thermostats. Hermetically sealed MH disk type and CH strip type units are described along with suggested applications. Bulletin L-4609 illustrates the operating principles and shows in detail dimensional drawings of the styles available for use where contamination is a problem. Ratings and construction data are tabulated for both types.

Compensated Radiation Detector. Brown Instruments Division, Minneapolis-Honeywell Regulator Co., Wayne and Windrim Aves., Philadelphia 44, Pa. The 28-page catalog 9300 completely describes the line of Radiamatic pyrometers. Included are sections on operation, theory, constructional features, engineering specifications, accessories and typical applications. Many photographs and line drawings supplement the written information.

Dry-Type Transformers. Allis-Chalmers Mfg. Co., 935 S. 70th St., Milwaukee, Wis. The proposed AIEE guide for the use of openly ventilated dry-type transformers with Class B insulation is contained in the 8-page bulletin 61X7088B. The guide gives general recommendations on installation, inspection, storage, maintenance and operation. It includes distribution and power dry-type transformers in ratings above 50 kva and above 600 v, cooled by natural draft or forced draft.

SECON

development and production

METALLURGISTS

BASE, RARE AND PRECIOUS METALS AND ALLOYS

SMALL UNITS

SMALL SIZES

CLOSE TOLERANCES

Nickel alloy, filament wire and ribbon: flat, grooved, crowned.

Grid wire electroplated.

Alloys for special requirements, bare or enamelled.

•

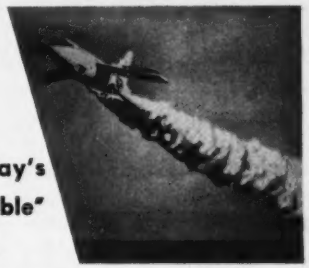
Further details upon request.

SECON

METALS CORPORATION

228 East 45th Street, New York 17, N. Y.

MUrray Hill 7-1594



Yesterday's "impossible" designs

are being executed successfully with Micro Ground Miniature Ball Bearings

America's first and only fully *ground* miniature ball bearings, Micro makes possible design refinements unheard of only a few years ago. With 85 sizes and types from 3/8" down to 1/8" o.d. and in tolerance ranges of ABEC-5 and above, Micro bearings offer tremendous opportunities to minimize space, weight and friction and at the same time to retain high capacity. Yet Micro precision ground bearings actually cost less than comparable *unground* miniatures.

Write for Technical Bulletin No. 50

New Hampshire MICRO Ball Bearings, Inc.

5 Main Street, Peterborough 1, N. H.

Runzel

WIRE, CORD and CABLE

SOLVE YOUR WIRING PROBLEMS

In almost endless variety of colors, sizes and specifications to your order, Runzel products will assist you in your wiring problems.

Shielded wire and cords . . . popular hook-up and lead-in wire . . . speaker cords and all types of insulated wire products.

Geared for fast production . . . Centrally located . . . our facilities for service are unexcelled.

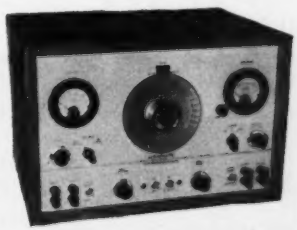
Write for samples.

RUNZEL CORD & WIRE CO.

4723 Montrose Avenue

Chicago 41, Illinois

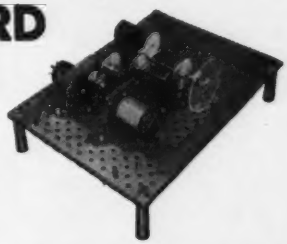
SERVOSCOPE®



Test analyzer for use in development and PRODUCTION of SERVOMECHANISMS and PROCESS CONTROLS. Measures FREQUENCY RESPONSE, PHASE SHIFT 0.1 to 20 CYCLES SINE WAVE, SQUARE WAVE, MODULATED CARRIER, 50 to 800 CYCLES.

SERVOBOARD

A FLEXIBLE SET of PRECISION mechanical parts for quickly coupling motors, synchros, potentiometers to form assemblies of Servo systems, regulators, computors.



SERVO CORPORATION OF AMERICA

DEPT. E-3 NEW HYDE PARK, N.Y.

News From The Field

Edited by WILLIAM P. O'BRIEN

Industry Announces Transfers and Promotions

SEVERAL companies in the electronics industry have recently announced staff reorganizations involving top positions. Among the more current we note the following:

Bell Telephone Laboratories organization changes promote three former IRE award winners. **Ralph Bown,** director of research there since 1946 and holder of the IRE's Medal of Honor, was appointed vice-president in charge of research. Two holders of the Morris Liebmann Memorial Prize have also advanced: **H. T. Friis,** from director of radio research to director of research in high frequency and electronics, and **W. H. Doherty,** from director of electronic and television research to director of research in electrical communications.

The Permoflux Corp. of Chicago has named **Eugene Roeske,** at one time product designer of aircraft radar equipment for Motorola Corp., to head its new transformer core division. **George Adams,** formerly with RCA, has been appointed factory superintendent to take charge of the production of loudspeakers, transformers and various electronic equipment manufactured by Permoflux.

Radio Corp. of America reports two changes. **Douglas Y. Smith** leaves the post of manager of the company's Lancaster, Pa., tube manufacturing plant to take over as manager of sales operations for the RCA Tube Department. **Earl M. Wood,** for the past 10 years manager of manufacturing at the Lancaster plant, succeeds D. Y. Smith as plant manager there.

Three new appointments have been announced by Allen B. Du Mont Laboratories, Inc. **Kenneth A. Hoagland,** with the organization for 11 years, has been named assistant manager of the Cathode-Ray Tube Division. **Nicholas DeFalco,** associated with the company since 1947, is now manager of the receiver quality control department. **Bernard Tullius,** formerly senior engineer at Radio Engineering Labs in Long Island City, N. Y., was recently appointed sales engineer for Du Mont's transmitter division. He will act as a sales and technical counselor to the company's clients, aiding them in planning, laying out and installing uhf and vhf transmitter equipment, coordinating transmitter design and construction, and supervising field work of many kinds.

Other position changes making news among engineers are the following:

Lauriston C. Marshall, former professor of electrical engineering at the U. of California, and head of the Microwave Laboratory operated at Berkeley, has been named director of Link-Belt Company's new Physical Testing and Research Laboratory at Indianapolis, Ind.

Steven E. Lasewicz, after 29 years with the Horton-Bristol Co. as chief engineer, is now production manager of the LaPointe Plascomold Corp., Windsor Locks, Conn.

Ferdinand W. Schor, previously associated with Hallicrafters Co., has been made chief engineer in charge of military engineering for Motorola, Inc., Chicago, Ill.

S. Norman Crawford, with GE since 1941, was recently named designing engineer for power electronic equipment in the company's tube department.

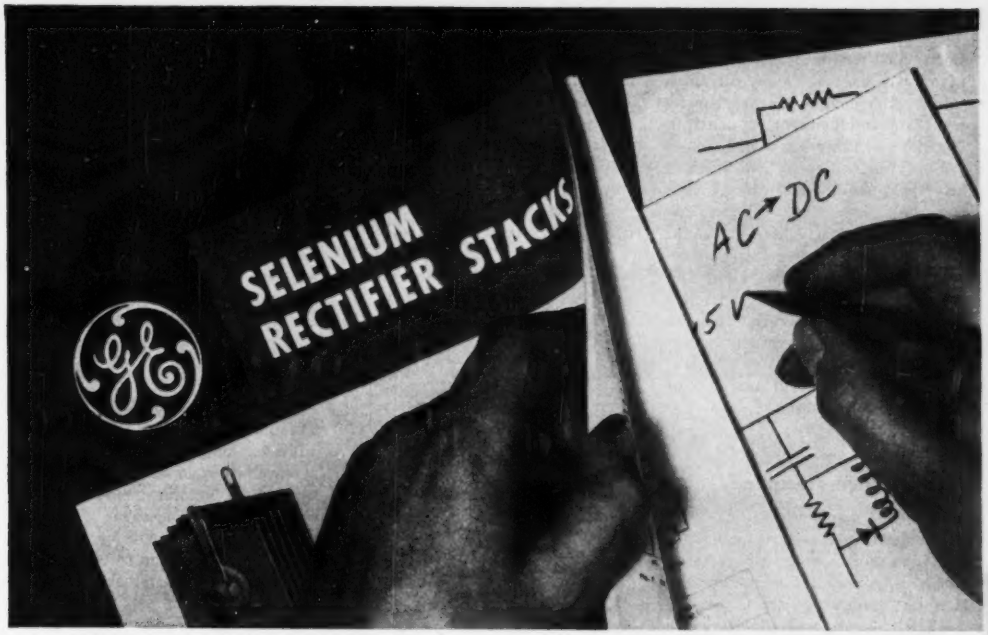
J. W. Phillips, formerly design and development engineer for the Electronic Tube Corp., Chestnut Hill, Pa., has been appointed a development engineer at The Riverside Metal Co., Riverside, N. J.

Irwin Weinstein, formerly assistant chief engineer of Sarkes Tarzian, rectifier division, has joined the staff of Electronic Devices, Inc., Brooklyn, N. Y., as assistant sales manager.

Charles E. Ellis, formerly assistant to the president, Ford Instrument Co. Div. of the Sperry

AUDIBLE SILENT MUSIC IN OPERATION

Inventor of the first silent electronic organ, N. D. N. Belham, science master at the Mid-Essex Technical School, Chelmsford, England, makes adjustments at the electric unit which operates the instrument. Up to 24 keyboards can be used, supplied from one tone unit in the console. Pupils can all play different pieces and listen to themselves on the earphones, while no sound is heard elsewhere. The teacher can listen in to any of the players, speak to them, correct their mistakes and play the correct version back to them



NEW G-E REFERENCE BOOK HELPS YOU SOLVE "A-C TO D-C" PROBLEMS

One of the most important and widely used metallic rectifier devices is the selenium stack. New applications where improved G-E selenium stacks are best suited are continually being discovered.

Now—for the first time—you can have a single, complete, practical guide to the selection and use of the proper G-E selenium stack for your application.

In this reference manual you'll find the answers to such questions as: What are the limits for current and voltage under normal and abnormal operating conditions? What are the most important factors in determining the life of a selenium rectifier? What should be done to avoid rectifier failure? How are G-E rectifiers rated? What are the "de-rating" limits? How are ratings adapted to resistive, inductive, capacitive loads?

Complete with charts, graphs and tables, this 28-page manual is the result of G.E.'s quarter of a century's experience in metallic rectifiers. Why not send for your copy today? *General Electric Co., Schenectady 5, N. Y.*

TABLE OF CONTENTS

1. INTRODUCTION

2. FUNDAMENTALS

Principles of Rectification • Manufacturing Processes • Construction of a Rectifier Stack Symbolic Notation • Basic Characteristics of Selenium Rectifiers

3. CIRCUIT DESIGN

Relationship of Voltage and Current Input-Output • Efficiency • Transformer Design Selenium Rectifier Ratings • Voltage Overloads • Current Overloads • High Temperature Operation • Forced-Air Cooling • Types of Loads • DC Blocking Operation • Location of Selenium Rectifiers in Equipment • Testing of Selenium Rectifiers

4. APPLICATIONS

Power Supplies • DC Blocking • Field Discharge and Arc Suppression • Electronic Applications • Magnetic Amplifiers

5. DEFINITIONS

General Electric Co., Section 461-21, Schenectady 5, N. Y.

Please send me a free copy of your new 28-page manual on selenium rectifier stacks, GET-2350.

☐ for reference only ☐ for planning an immediate project

NAME _____

COMPANY _____

ADDRESS _____

CITY _____ STATE _____

GENERAL ELECTRIC

Corp., has been appointed director of quality control there. Prior to joining the company last year he was an independent consulting engineer heading his own firm.

Erie Resistor Corp., Erie, Pa., has realigned its staff by moving two key executives. **Byron B. Minnium,** formerly vice-president in charge of engineering and research, is now vice-president and general manager of the Electronics Division. **Gordon Groth,** with the company as vice-president since July 1951, has been named vice-president and general manager of the Plastics Division.

Manufacturers Expand Facilities

ELECTRONIC plant development in the west continues to progress in factories geared either to production on defense contracts or for civilian markets or both. Here are some examples:

The Sierra Electronic Mfg. Co., San Carlos, Calif., recently completed a 10,000-sq ft expansion for the production of high-powered radio transmitters for the Navy.

Hoffman Radio Corp. has added 38,000 sq ft to its No. 5 plant at 6200 So. Avalon Blvd., Los Angeles, Calif., for tv set manufacturing.

Varian Associates, San Carlos, Calif., manufacturers of klystrons, will soon erect a million-dollar research lab in South Palo Alto, Calif.

International Rectifier Co. recently opened a new plant at 1521 E. Grand Ave., El Segundo, Calif. Main product is selenium rectifiers.

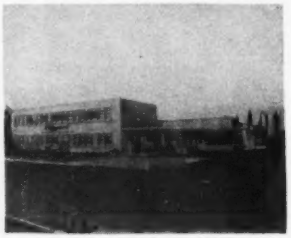
Establishment of a Pacific Coast application engineering office and radio noise suppression laboratory to better serve the growing electronics and aircraft industries of Southern California has been announced by the *Sprague Electric Co.*, manufacturers of capacitors and radio interference filters.

Construction of a major unit for the production of polyethylene resins has just been announced as an addition to the Texas City plant of *Carbide and Carbon Chemicals Co.*, a Division of Union Carbide and Carbon Corp.

Standard Cable Corp. of Chickasha, Oklahoma, with two plants in full operation producing combat telephone wire for Armed Service use, has also leased a third plant to meet commercial consumer requirements.

Company doings noted in the midwest are as follows:

Clippard Instrument Laboratory, Inc., Cincinnati, will soon move to a modern plant at 7350 Colerain Ave. between Mt. Airy and Groesbeck, Ohio, to keep pace with increased demand for test instruments, r-f coils, windings and subassemblies.



Sketch of new Clippard plant

As a part of a general expansion program, *The Reliable Spring and Wire Forms Co.*, Cleveland, Ohio, has moved into larger quarters in its present building for the increased manufacture of military electronic gear.

Plans for a new and larger manufacturing plant at 3601 Howard St., Skokie, Ill., were recently announced by *Ohmite Mfg. Co.*, Chicago, Ill., makers of electrical control equipment.

Multi-Tron Laboratory, Chicago, Ill., has moved to new and greatly enlarged quarters at 4624 W. Washington Blvd. in that city. The firm is engaged in electronic research and in the design and manufacture of special-purpose tubes, electron gun mounts, precision assemblies for vacuum tubes, and in tool and die fabrication.

To house its rapidly growing communications and electronics division, *Motorola Inc.*, Chicago, Ill., has purchased a 200,000-sq ft plant at 4501 Augusta Blvd., in Chicago.

The Fusite Corp., manufacturers of glass-to-steel hermetic terminals, has just occupied a new factory at 6028 Fernview Ave., Cincinnati, Ohio, providing 16,000 sq ft of floor space as compared with 7,000 in the old Carthage Ave. plant.

Admiral Corp., radio, tv and appliance manufacturer, has purchased the *Molded Products Corp.*, of Chicago, custom molders of plastics. The new plant, located at 4533 W. Harrison St., will be operated as a subsidiary of Admiral.

In the east the following company activities are reported:

Robertshaw-Fulton Controls Co. has purchased all the capital stock of the *Fielden Instrument Corp.*, Philadelphia, Pa. The corporation will continue to manufacture the Fielden line of industrial control instruments.

Microwave Associates, Inc., 22 Cummington St., Boston, Mass., will expand its operations in research, development and manufacture of microwave tubes, components and systems. The expansion program will be financed through the proceeds received from the sale of common stock to *United Paramount Theatres, Inc.*, which will own 50 percent of the outstanding common stock subsequent to the sale. Dana W. Atchley, Jr., coordinator of technical research, United Paramount Theatres, Inc., will become president of the enlarged company.

Kepco Laboratories, Inc., manufacturers of voltage-regulated power supplies and specialized electronic equipment, will soon house its production, research and development facilities in a new building at 131 Sanford Ave., Flushing, N. Y.

Electrical Reactance Corp. has been formally merged with the *Aerovox Corp.*, and will henceforth be known as *HI-Q Division, Aerovox Corp.*, Olean, N. Y.

Bomac Laboratories Inc., Beverly, Mass., engaged in the development and production of microwave tubes and devices, has completed a major expansion program making available 35,000 sq ft of floor space for manufacturing purposes.

IRE Convention Program

"FORTY YEARS SETS THE PACE" is the keynote of the 1952 IRE National Convention to be held on March 3, 4, 5 and 6 at the Waldorf-Astoria Hotel in New York City. Commemorating the 40th anni-

CONTROLLED QUALITY...

CUSTOM BUILT FOR GOVERNMENT AND INDUSTRY

TRANSFORMERS
REACTORS
RESONANT FILTERS

•

Top Engineering and Workmanship

FOR ELECTRONIC, INDUSTRIAL AND POWER APPLICATIONS

We have been solving the transformer engineering problems of government and industry since 1938!

Write or phone us regarding your special requirements.

ELECTRONIC TRANSFORMER COMPANY, INC.
209 West 25th Street • WAtkins 4-0880 • New York 1, N. Y.

WHERE QUALITY BEGINS

FREQUENCY SHIFT KEYER Model FSK 45

Meets all current military and commercial specifications . . . operates directly off teletypewriter. Circuits provided for phototransmission. For operation in frequency range 2.0 mcs. to 4.0 mcs. *Send for free copy of descriptive brochure.*

VARIABLE REGULATED D.C. POWER SUPPLY

Model PP180 Power Supply is an excellent source of direct current power for laboratory and production use.

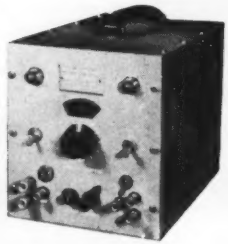
Specifications

***Output Rating*—180 to 360 volts DC at 100MA; 6.3 volts AC at 5 A. max.**

***Regulation*—Approximately 1% over the voltage range 180 to 360 volts, the current range 0 to 75 ma., and input voltage range of ± 10 volts.**

***Noise and Hum*—Total noise and hum is less than .005 volts for any rated condition of operation.**

***Input Rating*—Voltage—105 to 125 volts; Frequency—50 to 60 cycles/sec.; Wattage —90 watts max.**



VARIABLE FREQUENCY POWER SUPPLY

Variable Frequency Power Supply, Model V-S-500, designed as a power source over a wide frequency range for test purposes.

Specifications:

Input—115 to 230 volts, 60 cycles.
Output—115 to 230 volts regulated, 50 to 3,000 cycles, 500 watts.
Wave form—Sine wave, standard. Variable square to Sine optional.

See us at the IRE Show

RAD TELEVISION CORP.
1001 FIRST AVE., ASBURY PARK, N. J.

versary of the Institute, an outstanding program of technical sessions, Professional Group symposia and exhibits has been arranged. Sessions of the technical program will be held at the Waldorf, the Belmont Plaza and the Grand Central Palace. Six sessions and symposia are being held simultaneously each morning and afternoon with the exception of Monday morning, when the Annual Meeting will take place at 10:30 A.M. at the Waldorf.

Technical sessions are listed as follows:

Monday Afternoon, March 3

Symposium: SUBAUDIO INSTRUMENTATION

Direct Synthesis Applied to Subaudio-Frequency Instrumentation, by J. Moore.
Generating Equipment for Subaudio Frequencies, by E. H. Gamble.
Subaudio-Frequency Instrumentation in Seismographic Work, by W. M. Rust, Jr.
Oscillographic Instrumentation for the Subaudio Field, by P. S. Christaldi.

Symposium: MANAGEMENT OF RESEARCH AND DEVELOPMENT

Papers by W. R. G. Baker of GE; R. D. Bennett of NOL; G. N. Thayer of Bell Labs; and R. I. Cole of Griffiss AFB.

Symposium: TRANSISTOR CIRCUITS

Transistor Operation: Elements
(a) Equivalent Circuits, by J. A. Morton.
(b) Parameter Measurement, by V. P. Mathis.
(c) Stabilization of Operating Points, by R. F. Shea.
Transistor Band-Pass Amplifiers, by R. P. Moore.
Transistor Oscillators, by J. S. Schaffner.
Transistor Pulse Circuits, by J. H. Felker.

INFORMATION THEORY I—CODING PROCEDURES

Efficient Coding, by B. M. Oliver.
Television-Signal Statistics, by E. R. Kretzmer.
Coding with Linear Systems, by J. P. Costas.
Predictive Coding, by P. Elias.
Experiments with Linear Prediction in Television, by C. W. Harrison.

AUDIO

Microphones for the Measurement of Sound-Pressure Levels of High Intensity over Wide-Frequency Ranges, by J. K. Hilliard.
An Instrument for Measuring the Time-Displacement Error of Recorders, by E. N. Dingley, Jr.
A Method for Measuring the Changes Introduced in Recorded Time Intervals by a Recorder/Reproducer, by J. F. Sweeney.
Application of Electric-Circuit Analogies to Loud-Speaker Design Problems, by B. N. Locanthi.
A Sound-Survey Meter, by A. Peterson.

Symposium: NEW DEVELOPMENTS IN TELEMETERING

New Developments in Telemetering, by C. H. Hoeppner.
Recent Advances in Magnetic Recording for Telemetering Applications, by W. T. Selsted.
Fairchild Model 150 Telemetering Data Recorder, by C. F. Kezer.
Recording Telemetering Data, by M. V. Kiebert.
Telemetering by Pulse-Code Modulation, by B. D. Smith.

Tuesday Morning, March 4

INSTRUMENTATION I—HIGH-FREQUENCY INSTRUMENTATION

VHF Q—Measurement Techniques, by D. M. Hill.
A High-Sensitivity Method for Measur-

COMING

to all

subscribers

IN JUNE

the 12th

Annual

electronics

BUYERS' GUIDE

the first

completely

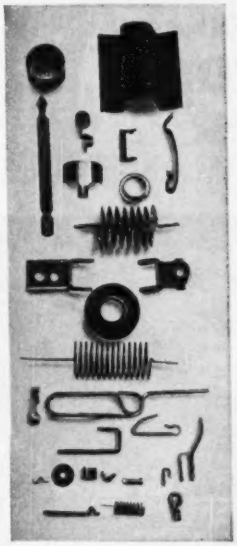
verified

directory

Priced Right!

WIRE FORMS

& *Metal Stampings*



High-speed, quality production with custom-made precision. Wire formed in any shape for every need.

IMMEDIATE CAPACITY FOR DEFENSE SUB-CONTRACTS

STRAIGHTENING & CUTTING
Perfect straight lengths to 12 ft.
.0015 to .125 diameter

WIRE FORMS
.0015 to .080 diameter

SMALL METAL STAMPINGS
.0025 to .035 thickness
.062 to 3 inches wide

Specializing in Production of Parts for Electronic and Cathode Ray Tubes

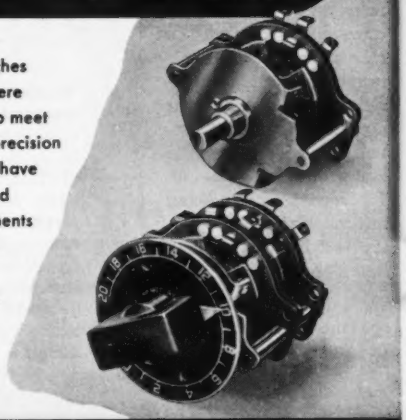
Write for illustrated folder.
Send Blueprints or Samples for Estimate.

ART WIRE and STAMPING COMPANY
1 BOYDEN PLACE
NEWARK 2, N. J.

Type 2A TAP SWITCHES

HAVE A CONSTANT CONTACT RESISTANCE OF

ONLY 1 or 2 MILLIOHMS!



These high quality switches with up to 24 contacts were specifically developed to meet the need for rugged precision instrument switches that have longer operating life and are economical components in competitively priced electronic instruments and military equipment.

●

Write for Technical Bulletin No. 28.

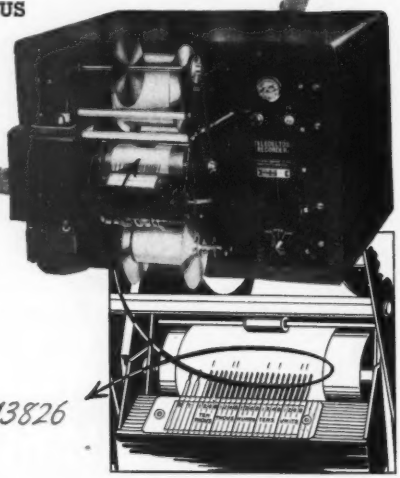
TECH LABORATORIES PALISADES PARK BOX 148, N. J.

NOW...9000 records per minute!

with the NEW POTTER high speed

TELEDELTOS RECORDER

IMMEDIATELY VISIBLE
INSTANTANEOUS
PERMANENT
DIGITAL



Designed to record measurements obtained on Potter Electronic counters, scalers, chronographs and frequency-time counters.

The Potter Instrument Co. High Speed Teledeltos Recorder provides a permanent recording of digital information at rates up to 150 six-digit answers per second. The measurements are transferred to electrically sensitive paper using four stylii for each digit arranged in the famous Potter (1-2-4-8) read-out. The records are indexed intermittently and controlled by the events being measured.

Write for information on specific applications to Dept. 6J.

POTTER RECORDING COUNTER CHRONOGRAPH

Measures time intervals up to 0.10000 second in increments of 2.5 microseconds. (Higher resolutions are also available.) Applicable to projectile velocity measurements, frequency measurements, geophysical measurements, telemetering and wherever micro-second timing is required.

POTTER INSTRUMENT COMPANY
INCORPORATED
115 CUTTER MILL ROAD, GREAT NECK, NEW YORK

ing Conductance and Capacitance at Radio Frequencies, by W. C. Freeman, Jr.

A Mean-Square Vacuum-Tube Voltmeter, by L. A. Rosenthal and G. M. Badoyannis.

A New Technique for the Evaluation of Leakage and Radiation from Signal Generators, by W. A. Stirrat.

A Wide-Band Sweep Generator, by F. P. Blecher.

TELEVISION I—GENERAL A

Gamma-Correction in Constant-Luminance Color-Television Systems, by S. Applebaum.

The Specification and Correction for Nonlinearity of Cathode-Ray Tubes, by R. C. Moore.

AFC-Circuit Analysis and Design, by G. D. Doland.

Frame Synchronization for Color Television, by D. Richman.

CIRCUITS I

Network Alignment Technique, by J. G. Linvill.

Network Analysis by a new Semi-Automatic Computer, by R. L. Bright and G. H. Royer.

Network Analysis by Two New Computers, by D. Herr.

Network Response Characteristics Using the Complex Plane Scanner, by J. R. Ragazzini and G. Reynolds.

Resonance Characteristics by Conformal Mapping, by P. M. Honnell and R. E. Horn.

INFORMATION THEORY II—NOISE STATISTICS AND SIGNAL DETECTION

Discussion of a Method of Expanding Noise Autocorrelation Function in a Power Series, by F. W. Lehan.

A Proposal for the Determination of Coherence in a Signal Field, by B. S. Melton and P. R. Karr.

The Response of Linear Systems to Random Noise, by B. Gold.

Optimum Methods of Noise Elimination, by C. N. Kiahr.

Optimum Techniques for Detecting Pulse Signals in Noise, by D. L. Drukey.

MICROWAVES I—WAVEGUIDES A

Microwave Wiring, by D. D. Grieg and H. Englemann.

Simplified Theory of TEM Propagation Along Conductor-Ground-Plane Transmission Systems, by F. Assadourian and E. Rimai.

Microwave Components for Conductor-Ground-Plane Transmission Systems, by J. A. Kostriza.

Method for Open Waveguide Standing-Wave Measurements, by S. W. Attwood and G. Goubau.

New Guided-Wave Techniques for the Millimeter Wavelength Range, by A. G. Fox.

Symposium: TELEVISION BROADCASTING: AUDIO AND VIDEO SYSTEMS

Fixed and Mobile Tv Lighting, by E. Fiorentino.

The Transient Response of Tv Transmitter-Receiver-Systems, by J. Ruston.

Measurement of Tv Field Intensities by Helicopter, by J. Preston.

A High-Power Uhf Klystron for Tv Service, by J. J. Woerner.

An Ultra-High-Frequency Television Transmitter, by E. G. McCall and P. T. Tissot.

Tuesday Afternoon, March 4

INSTRUMENTATION II—ELECTRONIC MEASUREMENTS A

Measurement of Impedance and Admittance, by B. Salzberg and J. W. Marini.

Accurate RF Microvolts, by M. C. Selby.

Automatic Switching Applied to Interelectrode Capacitance Measurements, by R. E. Graham.

Measurements of Millimeter Radiation with the Pneumatic Heat Detector, by H. Theissing, H. J. Merrill, and J. M. McCue.

Automatic Smith-Chart Impedance Plotter, by K. S. Packard.

TELEVISION II—COLOR

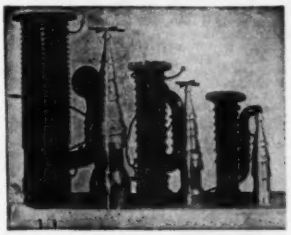
Requisite Color Bandwidth for Simultaneous Color-Television Systems, by K. McIlwain.

Colorimetric Electronics, by F. J. Bingley.

The Generation of Compatible Color Signals for Research and Field Testing, by J. Fisher.

A Universal Scanner for Color Tele-

Revolutionary
OIL DIFFUSION PUMPS



A completely new line of fractionating and miniature pumps. Ideal for tube and other high vacuum applications.

ON DISPLAY
BOOTH #453
IRE SHOW

OPTICAL
FILM ENGINEERING CO.
2735 North Sixth St.
Philadelphia 33, Pa.

Automatic On-Off Control For Remote Operation Of Auxiliary Electrical Circuits

The Vee-D-X Thermal Switch is the ideal electrical control for automatically opening and closing auxiliary circuits that operate in relation to a primary circuit. When the current flows through the heater element, the control circuit contacts are closed in the same manner as an electro-magnetic relay. Reliable switching functions are assured without manual aid. Accelerated life tests show 5 years of operation without failure. Small and compact in size, 1" x 2-1/16"; easy to install, only one hole mounting; fast self re-cycling; adjustable for precision setting; pure silver-to-silver contact; noiseless; mechanical stability, no springs; maximum controlled load, 50 watts; actuating load minimum, 100 watts at 117 v.; actuating load maximum, 500 watts at 117 v. For detailed information and prices write

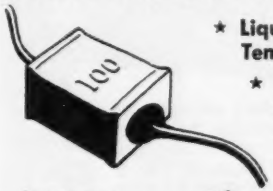
THE LaPOINTE-PLASCOMOLD CORPORATION
Windsor Locks, Conn.

How Hot is Your Application?

*Vitramon**

CAPACITORS
Can Meet it!

VITREOUS DIELECTRIC – MONOLITHIC STRUCTURE



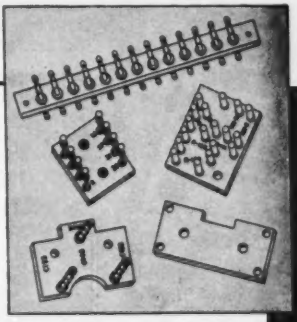
- ★ Liquid-Air-to-Liquid-Tin Temperature Range
- ★ Impervious to Atmospheric Conditions
- ★ Absolute Retrace
- ★ Miniature Size
- ★ Low Loss

In Stock from 0.5 to 1000 μμf

* Trade mark

Vitramon
INCORPORATED BOX 544 L • BRIDGEPORT • CONN.

TERMINAL BOARD ASSEMBLIES
by 'INDUSTRIAL'



Reduce Costs—Increase Production, by specifying INDUSTRIAL Terminal Board Assemblies. Our large facilities assure you of prompt deliveries to meet military production schedules.

- SOCKETS • TERMINAL STRIPS
- WIRED ASSEMBLIES • BAKELITE STAMPINGS

Consult INDUSTRIAL for all your requirements. Our representative in your area will be glad to assist you; write or phone for information and samples.

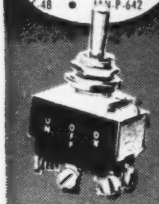
Phone: ORegon 7-1881

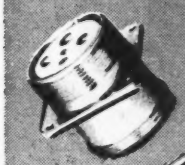
INDUSTRIAL HARDWARE Mfg. Co., Inc.
109 PRINCE STREET • NEW YORK 12, N. Y.

WE DON'T HAVE EVERYTHING

but we do have ALL

JAN COMPONENT PARTS. BROUGHT TO YOU BY WESTERN INTERNATIONAL COMPANY, THE INDUSTRY'S ONLY SPECIALISTS IN THE DISTRIBUTION OF CONNECTORS: JAN-C-71 (UG; AN) • COAXIAL CABLE: JAN-C-17A (RG) • SWITCHES: JAN-S-23 (ST; AN) • WIRE: JAN-C-76 (SRIR) and JAN-C-48 • PLUGS: JAN-P-642 (PL; PJ) • JACKS: JAN-J-641 (JK; JJ) • MICA CONDENSERS: JAN-C-5 (CM)





When all the shouting and hoopla are over, we'll all remember the truth of the old saying: "Jack of all trades, master o' none!" Nobody can have, or know, all about everything. But a real specialist can have, and know, about some things. We're real specialists. And this is why:

Restricting our efforts to the distribution of a selected group of electronic components, we've come to know those components thoroughly; and to carry a stock as complete as it can be made. Experts? You bet!

And that's why we can deliver all-the-way on the know-how, stock, and service that have earned us our reputation.

Recommendations? Suggestions? Just ask us! We'll talk shop around the clock. With a stock large enough to offer you complete selectivity, and on-the-spot delivery, we're just waiting to show you the best doggoned electronic components at the lowest doggoned prices you ever paid!

FREE!

Western's new 1952 JAN Catalogue. Please write on company letterhead, stating official position.

● DISTRIBUTORS FOR

Bussman Mfg. Co. ● Carling Electric, Inc. ● Electro Precision Products, Inc. ● Federal Telephone & Radio Corp. ● Hytron Radio & Electronics Co. ● Insuline Corp. of America (ICA) ● Kings Electronics Co., Inc. ● Littelfuse, Inc. ● Mueller Electric Co. ● Sangamo-Electric Co. ● Switchcraft, Inc. ● Waltham Horological Corp. ● Belden Mfg. Co. ● Tru-Connector Co., and others.

WESTERN *International Company*

45 VESEY STREET NEW YORK 7, N. Y. ★ TEL. Digby 9-2277

WELCOME I. R. E. CONVENTIONEERS

vision, by G. R. Tingley, R. D. Thompson and J. H. Haines.

Vestigial Sideband Transmission of the Color Subcarrier in NTSC Color Television, by W. F. Bailey.

CIRCUITS II AND INFORMATION THEORY III

Networks for Determination of Power-Spectra Moments, by S. H. Chang and W. H. Lob.

Nonlinear Filter Design on Maximum-Likelihood Basis, by T. G. Slattery.

Optimum Linear Shaping and Filtering Networks, by R. S. Berkowitz.

A Generalized Theory of Filtering and Multiplexing, by L. A. Zadeh and K. S. Miller.

Filter Transfer-Funotion Synthesis, by G. L. Matthaei.

Filters of Maximum Bandwidth-Impedance-Ratio Product, by T. J. O'Donnell and E. M. Williams.

A Band-Pass Filter Using Simulated Transmission-Line Elements, by A. D. Frost and C. R. Mingins.

MEDICAL ELECTRONICS

New Electronic Techniques for Spectrophotometry, by C. C. Yang.

Application of Microwaves in Physical Medicine, by J. F. Herrick.

Design Problems in the Absolute Oximeter, by R. H. Taplin.

Television Microscopy in the Ultraviolet, by V. K. Zworykin, L. E. Flory, and R. E. Shrader.

Recording Multi-Axial Projection of Vectorcardiograms; the Axostat, by B. P. McKay, W. E. Romans, D. A. Brody, and R. C. Little.

Continuous Integrating Counting-Rate System for Radioactivity, by M. Berman and S. Vacirca.

MICROWAVES II—WAVEGUIDES B

Nonuniform Transmission Lines, by J. G. Gurley.

The Optimum Piston Position for Coaxial-to-Waveguide Transducers, by W. W. Mumford.

Broad-Band Ridged and Flatguide Components 10-40 kmc/sec, by S. Hopfer.

Step-Twist Waveguide Components, by H. Schwiebert and H. A. Wheeler.

Waveguide Matching Technique, by W. C. Jakes, Jr.

Symposium: TV STATION CONSTRUCTION AND THEATER CONVERSION

The New WOR-TV Studio and Transmitter Building at 60th Street and Columbus Ave., New York City, by J. R. Poppele.

New Building and Technical Facilities at WCAU-TV, Philadelphia, by J. Leitch.

The WFAA-TV Plant, Dallas, Texas, by C. L. Dodd.

Theater TV Conversions.

NBC Program, by A. Walsh.

CBS Program, by A. B. Chamberlain.

ABC Program, by J. M. Middlebrooks.

Tuesday Evening, March 4

Symposium: PRESENT STATUS OF NTSC COLOR-TELEVISION STANDARDS

A panel of leading color-television engineers will discuss the most recent work of NTSC panels toward the preparation of standards for the NTSC color-television system. The discussion will include any available results of the field tests currently being conducted under such standards.

Wednesday Morning, March 5

INSTRUMENTATION III—ELECTRONIC MEASUREMENTS B

A Raster-Sweep Oscillograph for Precision Time Measurements, by H. B. Steinhauser.

Precision Automatic Time-Measurement Equipment, by D. W. Burbeck and W. E. Frady.

A Rotating-Beam Cellometer System, by R. H. Guenthner and L. W. Foskett.

A Polar-Coordinate Cathode-Ray Oscillograph for Use with the Rotating-Beam Cellometer, by M. T. Nadir and M. B. Kline.

An Electronic Fringe Interpolator for an Optical Interferometer, by R. D. Huntoon.

TELEVISION III—GENERAL B

The Problem of Interlace in Television Receivers, by J. de Leon.

A Method of Evaluating the Performance of a Television Picture Tube and its

400%

MORE PRODUCT LISTINGS

...in the coming (Mid-June) electronics

BUYERS' GUIDE

than in any similar directory

EDWARD E. ROBINSON

METERING PUMP

Pots Transformers

for FTR *FASTER*

Federal Telephone and Radio Corporation reports increased production and reduced loss of compound in potting transformers by using the Robinson Metering Pump. You, too, may benefit by investigating this new production tool.

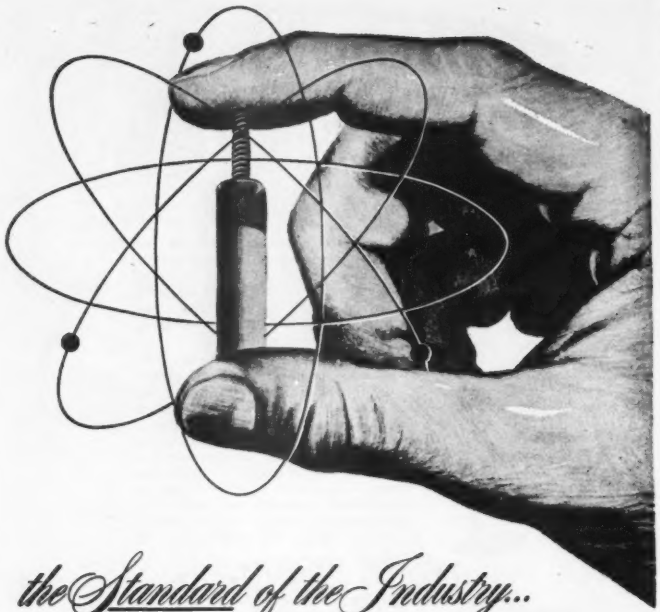
Specifications: Adapts to any production technique. Not a gravity dispenser — Forcibly ejects hot waxes and cements. Thermostatically controlled heat — Variable with a maximum reservoir temperature of 450°F. Motor driven, clutch actuated — 2/3 second per ejection. Variable discharge — Ejection changed in 2 seconds, without tools. Reduced unit costs — No skilled operator required. Saves material — reduces rejects. Write for Bulletin No. 2A.

EDWARD E. ROBINSON
INCORPORATED
85 PARK AVENUE • NUTLEY 10, N. J.

For every electronic application Acme Electric can design and produce transformers that provide for better performance, long life service. Our experience in miniaturization and MIL-T-27 specifications may help you solve transformer application problems.

ACME ELECTRIC CORP.
313 WATER STREET • CUBA, NEW YORK

Acme ACME **Electric**
TRANSFORMERS



the Standard of the Industry...

MOLDITE IRON CORES

Moldite offers the advantages of volume production combined with absolute precision . . . the sure results of its special formulas and advanced production techniques . . . engineering cooperation on every iron core application. Moldite Iron Cores meet every requirement for dependability. They are the standard wherever the finest in electronic equipment is made.

MAGNETIC IRON CORES • FILTER CORES • MOLDED COIL FORMS
THREADED CORES • SLEEVE CORES • CUP CORES

NATIONAL

MOLDITE

COMPANY

1410 Chestnut Ave., Hillside 5, N. J.

Samples promptly submitted upon request for design, pre-production, and test purposes

SEND FOR CATALOG 110

Robert T. Murray	Jerry Golton Co.	Martin P. Andrews	Perkuoth-Colman & Assoc.	Jose Luis Pontet
614 Central Ave.	2750 W. North Ave.	Mott Road	1335 South Flower	Curioba 1472
East Orange, N. J.	Chicago 22, Ill.	Fayetteville, N. Y.	Los Angeles, Cal.	Buenos Aires

Associated Components, by J. Green.
Characteristics and Performance of Television Clamping Circuits, by A. J. Baracket.
Color-Television Synchronizing—Generator Circuits, by I. Krause, A. J. Baracket, and H. Deil.
Printed Unit Assemblies for Television, by W. H. Hannahs and N. Stein.

CIRCUITS III

The Effective Bandwidth of Video Amplifiers, by F. J. Tischer.
Transient Response of Cathode Peaked Video Amplifiers, by J. H. Mulligan, Jr.
Variable Bandwidth-Amplifier Design for High Rate of cutoff and Large Bandwidth Variations, by M. Dishal.
Coupling Circuits Having Flat-Amplitude Characteristics, by A. B. Macnee.
Oscillator Systems Controlled by Phase-Detector Reactance Tube, by J. C. Tellier and G. W. Preston.
Essential Insertion Loss, by D. R. Crosby.

PROPAGATION

The Polarization of Vertically Incident Long Radio Waves, by J. M. Kelso, H. J. Nearhoof, R. J. Nertney, and A. H. Waynick.
Radio Transmission Beyond the Horizon in the 40-4,000 Mc Band, by K. Bullington.
Tropospheric Propagation Data on Frequencies Between 29 and 1,047 Mc at Distances Far Beyond the Horizon, by G. R. Chambers, J. H. Chisholm, J. W. Herbstreit, and K. A. Norton.
Statistical Fluctuations of Radio Field Strength Far beyond the Horizon, by S. O. Rice.
Some Considerations in the Use of Highly Directional Antennas on Sources of Comparable Angular Size to the Beamwidth, by D. O. McCoy.

MICROWAVES III—
FILTERS AND CIRCUITS

Further Transmission Analysis of Hybrid Rings, by H. T. Budenbom.
Resonant Cavity Band-Pass Filters—Practical Adustment to Predicted Performance, by D. DeWitt, M. Klein, and T. J. Potts, Jr.
Synthesis of Narrow-Band Direct-Coupled Filters, by H. J. Riblet.
On High-K Dielectric Cavities, by H. M. Schlicke.
A Dual-Channel Colinear Rotary Joint, by E. O. Hartig.

Symposium: DIGITAL COMPUTERS IN CONTROL SYSTEMS

Digital Computers in Control Systems, by J. W. Forrester.
Coders, by R. P. Mork.
Data Transmission Links, by P. Pontecorvo.
The Digital Computer as a Control Element, by C. R. Wieser.
Display Elements, by B. S. Benson.

Wednesday Afternoon, March 5

ANTENNAS I—GENERAL

Optimum Patterns for Arrays of Non-isotropic Sources, by G. Sinclair and F. V. Cairns.
A Geometrical Method of Analyzing the Effects of Site Reflections on Direction-Finding Systems, by G. A. Deschamps.
The Radiated Fields of Pulse-Excited Dipole Antennas, by C. S. Roys.
An Experimental Investigation of the Corner Reflector Antenna, by E. F. Harris.
An Omnidirectional Slot Antenna Array, by A. J. Hoehn and S. I. Cohn.

Symposium: UHF RECEIVERS I

UHF Hybrid Ring Mixers, by W. F. Tyminski and A. E. Hylas.
UHF Tuners, by M. F. Melvin.
The Design and Performance of a Compact UHF Tuner, by H. F. Rieth.
A UHF-VHF Turret Tuner for Television Receivers, by A. Cotsworth, M. Beier, J. Bell, and J. White.
An 82-Channel Turret Tuner, by A. M. Scandurra.
RF Performance of a New Uhf Triode, by H. W. H. Chalberg.

CIRCUITS IV

Dispersion in Transmission Systems, by M. J. DiToro.
Network Synthesis for Specified Transient Response, by W. H. Kautz.
Transforms for Linear Time-Varying Network Functions, by J. A. Aseltine and D. L. Trautman.
Parallel-Tuned Circuit Periodically

ELECTRONIC ENGINEERS

AT

DU MONT TELEVISION

Senior, Intermediate, and Junior

for

Interesting Career Opportunities in

Design, Development, and Research

Ultra-High Frequency work, Radar Systems, transmitting equipment, electronic instruments, and Cathode-ray tubes. Openings also for men experienced in pulsing, sweep, sync, multi-vibrator, Video Circuits, RF circuits, and IF systems.

DU MONT

Pioneer in Television and Electronics

offers to qualified men high starting salaries, defense and peace-time job permanency, excellent advancement possibilities, regular merit reviews, and interesting work assignments.

Moving costs may be assumed by the Company for successful applicants. If possible, interviews will be arranged in your city.

Send complete information to

ALLEN B. DU MONT LABORATORIES, INC.

Mr. George Kaye, Dept. E-3
35 Market Street
East Paterson, New Jersey

PROBLEM

Regardless of the intricacies of an application, you can depend on prompt and thorough evaluation by experienced engineers of — The A. W. Haydon Company

timing

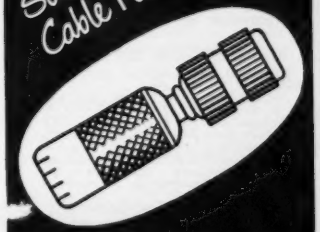
SOLUTION

From problem statement through quantity production, the specialized know-how of The A. W. Haydon Company is devoted to expeditiously fulfilling your requirements.

WRITE FOR CATALOG

The A.W. HAYDON COMPANY
235 NORTH ELM STREET
WATERBURY 20, CONNECTICUT
Design and Manufacture of Electrical Timing Devices

Solderless Cable Fittings



WORKSHOP provides a complete line of solderless cable fittings for RG-59/U, RG-11/U and RG-8/U coaxial cables—all in current production and available in large quantities. Pictured above is the W-50 male cable connector, silver plated and specially slotted to withstand strain. Write for catalog and complete specifications.

THE WORKSHOP ASSOCIATES
Division of the Gabriel Co.
135 Crescent Road
Needham Heights 94, Mass.

NOW! ELECTRO-TECH'S

OFF-THE-SHELF SERVICE

can save months on your schedule

ONE SOURCE OF SUPPLY for all kinds of ELECTRICAL METERS, INSTRUMENTS and INDUSTRIAL CONTROLS

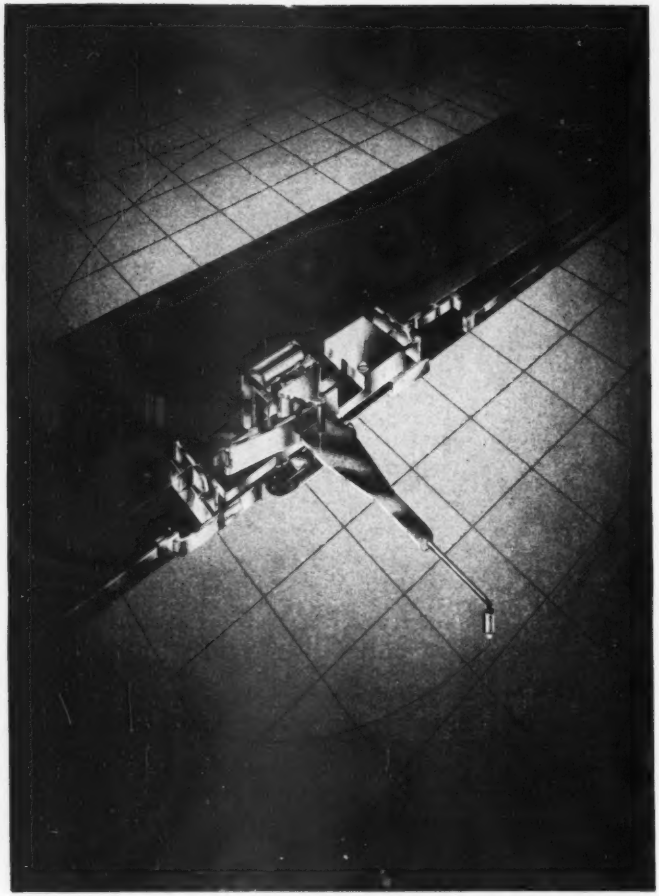
No need to hold up production for lack of a meter, controller or other instrument! Electro-Tech's warehouse is bulging with panel meters, solenoids, transformers, rectifiers, timers, counters and every other kind of meter and control device.

Plus—complete laboratory facilities to convert, repair and re-scale stock meters and instruments to fit your needs.

- SIMPSON
- WESTON
- STRUTHERS-DUNN
- MICRO SWITCH
- SUPERIOR ELECTRIC
- GENERAL ELECTRIC
- WHEELCO

FREE! PURCHASING GUIDE
Write today!

ELECTRO-TECH EQUIPMENT COMPANY,
Dept. E-3 55 Lispenard St.,
New York 13, N. Y.
Phone: BA 7-4209
Wire: CODE RDL
Teletype: TWX-NY1-2906



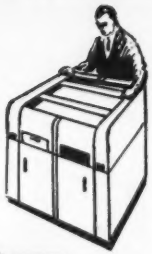
This is a pen of a Variplotter plotting board.

Function: Plots D.C. voltages x vs. y or x_1 vs. y_1 and x_2 vs. y_2.

Surface: Thirty inch square plotting surface.

Accuracy: .05% static. .1% dynamic.

Information: Contact Electronic Associates, Inc. Long Branch, N. J.



ELECTRONIC ASSOCIATES Incorporated

Variplotter

MODEL 205 SERIES PLOTTING BOARDS

LONG BRANCH, NEW JERSEY

Switched to a D-C Source, by L. J. Giacoletto.

A Highly Accurate Variable Time-Delay System, by Y. P. Yu

RC Time-Delay Circuit of Very High Time Constant, by R. G. Roush.

ELECTRON TUBES I—POWER AND GAS TUBES

Method for Prediction of Magnetron Characteristics Relating Frequency and Operating Anode Voltage to Power Output, by H. W. Welch, Jr.

A New Pulse Klystron Amplifier for the 960-1,215 Mc Region of Air Navigation Aids, by C. Veronda.

Uhf Power Tubes, by P. T. Smith.

High-Frequency Performance of Electron Multipliers, by R. R. Law, D. A. Jenny, and F. H. Norman.

Factors Affecting Life of Hydrogen Thyratrons, by M. R. Zinn.

RADAR AND RADIO NAVIGATION

Design of Small Radar Line-Type Modulators with A-C Charging Circuits, by J. F. Clayton and S. J. Krulikoski, Jr.

High-Quality Picture-Display Unit, by R. T. Petruzzelli.

Analysis of an Automatic Radar Range-Tracking System, by E. F. Grant.

The Wind-Finding Radar System, by A. D. Emurian.

Power Requirements for Long-Range, Narrow-Band Navigation Systems in the Low-Frequency Bands, by N. Marchand, A. Jacobs and D. Cawood.

Symposium: MAGNETIC-CORE MEMORY DEVICES FOR DIGITAL COMPUTERS

An Analysis of Magnetic Delay Line Operation, by E. A. Sands.

Design of a High-Speed Shift Register Using Magnetic Binaries, by M. Fishman.

Magnetic-Core Matrix Switches, by K. H. Olsen.

Static Magnetic Matrix Memory and Switching Circuits, by J. Rajchman.

The Ferro-Resonant Flipflop, by C. L. Isborn.

Thursday Morning, March 6

ANTENNAS II—MICROWAVES

A Gain of Electromagnetic Horns, by E. H. Braun.

A Rapid-Scan, Circularly Symmetrical Pillbox Antenna, by W. Rotman.

Method for Side Lobe Reduction, by C. J. Sletten.

Tolerances on Paraboloidal Reflectors, by J. Ruze.

Design of Dielectric Walls for Optimum Transmission, by R. M. Redheffer and B. Galvin.

Symposium: UHF RECEIVERS II

Practical Tv Antennas for Uhf Reception, by E. O. Johnson.

Amplifiers for Uhf Distribution Systems, by T. Murakami.

Comparison of Present-Day Uhf and Vhf Television Receivers, by R. A. Varone.

Round-Table Discussion: Relative Aspects of the Various Methods of Uhf Tuning—Introductory Remarks—W. B. Whalley; Moderator—L. Winner.

FEEDBACK CONTROL

Stability Theorems for Feedback Systems, by J. F. Koenig.

Stabilization of Nonlinear Feedback Control Systems, by R. L. Cosgriff.

Rate-Limited Control System Noise, by I. H. Van Horn and R. G. Wilson.

Experimental Studies for Servomechanisms, by A. V. Cohee.

AFC System Analysis by Electromechanical Analogue, by D. Leed.

ELECTRON TUBES II—UHF, SMALL TUBES

A High-Gain Klystron Amplifier for Relay Systems, by G. Bernstein.

F-m Distortion in Reflex Klystrons, by T. Moreno and R. L. Jepsen.

The Measurement of Cathode Interface Impedance, by H. R. Frost.

Uhf Amplifier Tube for Television Tuners, by C. E. Horton and H. Hsu.

Microwave Conversion and Detection Employing Electron Tubes, by A. Bronwell, J. May, and C. Nitz.

Symposium: THE INTEGRATION OF ELECTRONIC EQUIPMENT WITH AIRFRAME DESIGN

The Integration of Electronic Equipment with Airframe Design, by A. F. Coombs and C. W. Dix.

The Unique Airplane Environment Ef-

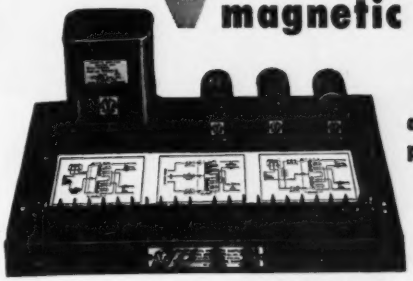
Exclusives in the coming (Mid-June) electronics

BUYERS' GUIDE

include:

- **a cumulative editorial index to ELECTRONICS, 1940-1949 inclusive**
- **extensive trade name listings**
- **geographical listings of distributors**
- **simple telephone book type product listings**

VICKERS **educational magnetic amplifier**



Permits study of all three basic single phase self-saturating circuits

- For Industrial Laboratories — Schools.
- Can actually be used in operating controls circuits.
- Gives d-c or a-c output . . . uses d-c or a-c control power.

Designed by Vickers Electric Division to help industrial personnel and students obtain a wider knowledge of the characteristics and applications of high-performance self-saturating magnetic amplifiers.

Complete with Magnetic Amplifier Laboratory Manuals and Magnetic Amplifier Design Handbooks.

Write for literature and price.

VICKERS ELECTRIC DIVISION

1801 LOCUST STREET • ST. LOUIS 3, MISSOURI

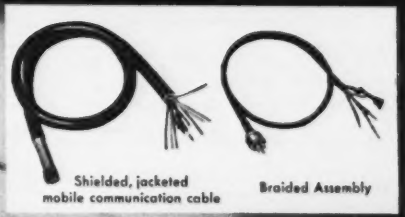
PHALO

"Current's Favorite Conductor"

Provides Versatile Quality for Mobile Communication!

Year after year, hundreds of thousands of feet of shielded connecting cables bearing the famous "Current's Favorite Conductor" trademark, find their way into the nation's best mobile radio and telephone communication systems.

Phalo builds shielded cables that are as versatile as the systems they connect . . . whatever the purpose, you couldn't find a better quality answer. Next time specifications call for shielded communication cable, call for PHALO and be certain!



Shielded, jacketed mobile communication cable

Braided Assembly

PHALO Plastic Corporation

Manufacturers of Thermoplastic Insulated [illegible] Cord Sets and Tubing to Government [illegible]

CORNER OF COMMERCIAL STREET, WORCESTER, MASSACHUSETTS

LITTELFUSE

MOLD-SEALED PRESSURIZED FUSE POSTS FOR 3AG, 4AG AND 5AG FUSES WATERTIGHT

LITTELFUSE, INC. 4757 RAVENSWOOD, CHICAGO 40

fect on Electronic Equipment, by D. T. Geiser.
Electronic Parts for Airborne Requirements, by F. E. Wenger.
Heat Dissipation from Airborne Electronic Equipment, by L. Possner.

DIGITAL COMPUTERS

The CADAC, by W. E. Dobbins.
Analysis of Control Systems Involving Digital Computers, by W. K. Linvill.
Frequency Analysis of Digital Computers Used in Control Systems, by J. M. Salzer.
A Very Rapid Access Memory Using Diodes and Capacitors, by A. W. Holt.
The Charactron, J. T. McNaney.

Thursday Afternoon, March 6

ANTENNAS III—MICROWAVES B

A Microwave Luneberg Lens, by G. D. M. Peeler, D. H. Archer, and K. S. Kelleher.
Radiation from Metal-Loaded Waveguides Terminated in a Ground Plane, by R. E. Webster and M. H. Cohen.
Mutual Coupling between Slot Radiators, by M. J. Ehrlich, C. W. Curtis, and R. G. Fawcett.
Off-Axis Characteristics of Paraboloids and Spheres, by K. S. Kelleher.
A Broad-Band Axially Symmetric Vertex Feed, by F. L. Hennessey.

RADIO COMMUNICATION SYSTEMS

A Radio-Relay System Employing a 4,000-Mc Three-Cavity Klystron Amplifier, by J. J. Lenehan.
An Fm Microwave Radio Relay, by R. E. Lacy and C. E. Sharp.
Nonsynchronous Pulse Multiplex System with Random Sampling, by J. R. Pierce and A. L. Hopper.
Exalted-Carrier and Single-Sideband Diversity Receivers, by M. G. Crosby.
Counter Circuit for a Broad-Band Multiplex Receiver, by A. R. Vallarino, H. A. Snow and C. Greenwald.

CIRCUITS V

Analysis of Measurements on Magnetic Ferrites, by C. D. Owens.
Magnetic Amplifier Performance Analysis, by D. Lebell and B. Bussell.
Barium Titanate Properties, by A. I. Dranetz.
A Ferroelectric Amplifier, by H. Urkowitz.
Germanium Diode Transient Response, by J. H. Wright.
Germanium Diode Testing Program, by D. J. Crawford and H. F. Heath.
Analysis of Crystal Diodes in the Millivolt Region, by W. B. Whalley, N. P. Salz, and C. Masucci.

ELECTRON TUBES III—CATHODE-RAY TUBES

The Anatomy of Contrast Range in Cathode-Ray Tubes, by J. H. Haines and R. E. Mueller.
The Selfocus Picture Tube, by A. Y. Bentley, K. A. Hoagland, and H. W. Grossbohlin.
A New High-Speed Cathode-Ray Tube, by H. J. Peake and R. W. Rochelle.
The Deflectron—A New System for Electrostatic Deflection, by K. Schlesinger.
Field Plotting as a Tool in Deflection-Yoke Design, by E. Sieminski.

Symposium: WHAT'S NEW IN MOBILE RADIO

Mobile Radio Problems Resulting from New Techniques, by E. L. White.
Application of Voice-Frequency Tone Signalling to Mobile Radio Systems, by C. L. Rouault.
Dispatcher's Wayside-to-Train Radio-Control System, by S. D. Burton.
New Developments in Army Mobile Communication Equipment, by J. H. Durrer.

Symposium: RELIABILITY OF MILITARY ELECTRONIC EQUIPMENT

Discussion of the Complexity and Unreliability of Military Equipment and the Need for Simplification and Increased Life, by A. S. Brown.
Maintenance Minimization in Large Electronic Systems, by W. D. McGuigan.
The Reliability Problems in Missile Development, by A. C. Packard and R. Weller.
Application Engineering for Improved

For SURE Government
Specification Jobs . . . CHOOSE
DANDUX CANVAS &
LEATHER PRODUCTS

TOOL ROLLS
BAGS & CASES
BG BAGS
CW BAGS
RADIO EQUIPMENT
ELECTRONIC EQUIPMENT
RADAR EQUIPMENT

C. R. DANIELS, INC.
75 West St., NEW YORK 6, N. Y.
549 W. Randolph St., Chicago 6, Ill.

Partially wound bobbin-type coil

Here at Coto-Coil . . .

. . . bobbin type coils are produced in mass production quantities . . . yet with craftsman-like precision . . . to rigid specifications. In this battery of Bobbin Winders notice that each machine winds three coils simultaneously. The winding speed is timed so that two coils are winding at all times while the operator resets the third. Such modern production facilities, plus 35 years of experience, combine to make Coto Coils the first choice for engineered coils. Coto-Coil Company, 67 Pavilion Avenue, Providence 5, R. I.

Coto PRECISION WOUND **Coils**

PICKERING
solenoids

for DC Circuits

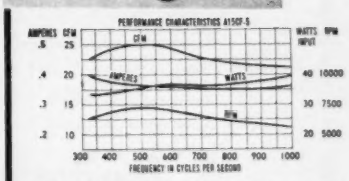
Pickering engineering service is available for special applications where Pickering standard Solenoids do not apply.

PICKERING & CO., Inc.

Manufacturers of world-famous electro-magnetic phonograph cartridges and audio equipment.
Oceanside, L. I., New York

For details and literature address Department N

THE LATEST IN VARIABLE FREQUENCY BLOWERS WITH FLAT SPEED TORQUE CURVES



TYPE A15CF-5: Centrifugal blower, variable frequency capacitor induction motor driving LR #2 blower, single phase, self cooled, weight 220 oz., 23 CM, NEMA, (free air) average delivery, 6250 RPM average speed, 115 volts, 320-1000 cycles can be supplied with CW and CCW. This unit is designed with silicone insulation and impregnation and is used to cool a high power vacuum tube which requires a maximum of air speed over the entire frequency range and in particular over an altitude range of sea level to 50,000 feet.

Example above is indicative of our "know-how" design ability. May we aid in the solution of your problem?

Ruggedly constructed durable motors (precisionly designed for 400 cycles — 60 cycles — variable frequency) operating dependably in equipment requiring specialized performance, are being produced with superior accuracy through the advanced ideas of our designing engineers.

Experimental production, made possible through flexible engineering experience plus experienced production, has resulted in production designs that include motors for fan and blower duty as well as power and drive motors; these will be made exclusively for the electronic industries supplying equipment for military applications.

Ours is an experienced organization with engineering model shop and electrical laboratory for prototypes — this means you gain personnel with "know-how" to solve your special motor and A.C. power problems.

SEE US AT THE SHOW • BOOTH 406

AIR MARINE MOTORS INC.
2183 JACKSON AVENUE, SEAFORD, L. I., N. Y.
WAshash 2-7389

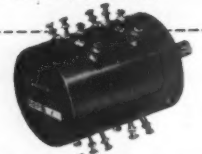
potentiometers

Synchromount

Linear and functional output, rugged construction, ball bearings, small size, low torque, syncro-type mount.

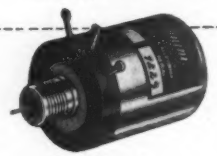
Rectipot

Push-pull motion, linear and functional output, high resolution, rectilinear potentiometer.



Gangpot

Functional and linear outputs, coils independently adjustable, variety of flexible assemblies.



Microtorque

Linear output, minimum torque, potentiometer and selsyn outputs, most ultra sensitive of them all.

These potentiometers are available in a variety of resistance values and circuits. For details on these and other fine instruments, write:

G. M. GIANNINI & CO., INC.
Pasadena 1, Calif.

Giannini

Electronic Reliability in Guided Missiles, by W. T. Summerlin.

Mobile Army Broadcasting

THE ARMY'S mobile radio station now being used in Korea was described in ELECTRONICS last month (p 316). Units involved, designed for Psychological Warfare Teams, were developed, as to specifications, by the Signal Corps.

This station was built by Gates Radio Co. of Quincy, Ill. Other major units were procured from the Hammerlund Corp. and Pan Adapter Co. of New York and the Magnecord Corp. of Chicago, Ill. The project was coordinated by Coles Signal Laboratory, Red Bank, N. J.

CCIR Codes for Reporting Signals

ALTHOUGH FCC does not require their use, the new international SINPO and SINPFEMO signal-quality reporting codes are being published for the convenience of communicators, particularly those handling international traffic.

A signal report shall consist of the code word SINPO or SINPFEMO followed by a five or eight-figure group respectively rating the five or eight characteristics of the signal code. The letter X shall be used instead of a numeral for characteristics not rated. Although the code word SINPFEMO is intended for telephony, either code word may be used for telegraphy or telephony as may be desired. The overall rating for telegraphy shall be interpreted according to the table of Signal Quality Criteria.

SINPO Signal Reporting Code

Rating Scale	S	I	N	P	O
	Signal Strength	Degrading effect of			Overall readability (QRK)
		Interference (QRM)	Noise (QRN)	Propagation disturbance	
5	Excellent	Nil	Nil	Nil	Excellent
4	Good	Slight	Slight	Slight	Good
3	Fair	Moderate	Moderate	Moderate	Fair
2	Poor	Severe	Severe	Severe	Poor
1	Barely audible	Extreme	Extreme	Extreme	Unusable

SINPFEMO Signal Reporting Code

Rating Scale	S	I	N	P	F	E	M	O
	Signal strength	Degrading effect of			Frequency of fading	Modulation		Overall Rating
		Interference (QRM)	Noise (QRN)	Propagation disturbance		Quality	Depth	
5	Excellent	Nil	Nil	Nil	Nil	Excellent	Maximum	Excellent
4	Good	Slight	Slight	Slight	Slow	Good	Good	Good
3	Fair	Moderate	Moderate	Moderate	Moderate	Fair	Fair	Fair
2	Poor	Severe	Severe	Severe	Fast	Poor	Poor or nil	Poor
1	Barely audible	Extreme	Extreme	Extreme	Very fast	Very poor	Continuously overmodulated	Unusable

Signal Quality Criteria

	Mechanized Operation	Morse Operation
5 Excellent	4-channel Time Division Multiplex	High-Speed Morse
4 Good	2-channel Time Division Multiplex. Single Start-stop Printer	100 wpm Morse
3 Fair	Marginal. Single Start-stop Printer	50 wpm Morse
2 Poor	Equivalent to 25 wpm Morse	25 wpm Morse
1 Unusable	Possible BK's, XQ's (service instructions), call letters distinguishable	Possible BK's, XQ's, call letters distinguishable

COMING

to all

subscribers

IN JUNE

the 12th

Annual

electronics

BUYERS' GUIDE

---

the first

completely

verified

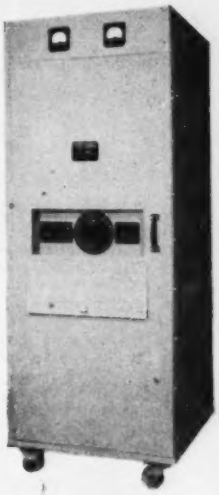
directory

It's New!

CML Model 1435

VARIABLE FREQUENCY ELECTRONIC GENERATOR.

Here is a high powered audio generator designed to provide for the increasing power requirements of air borne radio and radar test facilities.



PERFORMANCE DATA

- Power output 2.2 KVA!
- Power input 208–220V 50–60 cycles single phase 5KVA
- Frequency range 50–6000 cycles in four ranges: 50–180, 170–600, 540–1800, 1700–6000
- Frequency stability better than 1%
- Distortion less than 7% at full 2.2 KVA load with unity power factor
- Output voltage regulation from no load to full load 1%
- Nominal output voltage 120V RMS

Write for the new CML Catalog describing the Model 1435 Generator and other CML products.

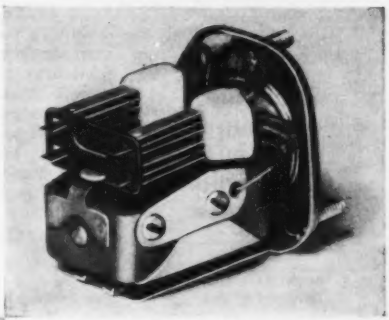
COMMUNICATION MEASUREMENTS LABORATORY, INC.

120 Greenwich Street, New York 6, N. Y. Tel. REctor 2-2080

New G-E Hermetically-Sealed Relay Protected from Breakdowns

Cuts Down on Relay Replacements

General Electric's new aircraft relay is more highly arc-resistant, has non-tracking stack insulation, because of a revolutionary technique for directly molding contact arms into a polyester compound.



Rated at 28 volts d.c., the relay withstands surges up to 1500 volts.

A more powerful magnet structure yields a higher tip pressure, adds to the surety of making contacts. And the relay is available for quick shipment. Write Section 730-38 for Bulletin GEA-5729.

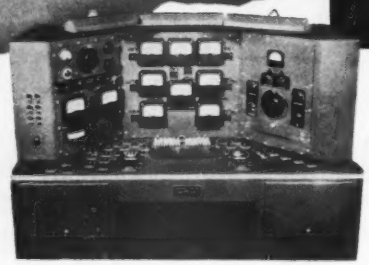
General Electric Co., Schenectady 5, N. Y.

730-38

GENERAL ELECTRIC

Specify BUCK -for practical solutions to problems of DESIGN-ENGINEERING -IN PRODUCTION ORDNANCE TESTING RESEARCH

Buck has the capabilities and facilities to work with your engineering staff from the initial planning stage. Also, Buck can work out construction details using your rough sketches or specifications. Either way, you are assured of sound, practical design on special equipment or production pieces. Buck experience solves your problems economically, by painstaking attention, from st... finish. Write for folder.



Power output Test Set. Laboratory unit designed and built for Sperry Gyroscope Co. Measures AC gain and power output of receiving tubes.

COMPLETE FACILITIES FOR
SHEET METAL WORK

INCLUDING
- SHEARING
- BENDING
- CUTTING
- BURNING
- WELDING
- MACHINING
- FINISHING

Fully equipped sheet metal shop including engineering, drafting and planning department. Buck fabricates mild steels up to 12 gauge, stainless, monel, aluminum, copper, galvanized iron. Buck will work from your rough sketches, finished blueprints or design the job for you. Call or write for estimates or full information.

BUCK STANDARD TUBE CARRIERS
Designed to facilitate TV tube production by providing safe handling of costly tubes. One of the many standard Buck developments available to manufacturers. Complete catalog on request.

BUCK engineering co., inc.
DESIGNERS AND BUILDERS OF ELECTRONIC, ELECTRICAL AND MECHANICAL INSTALLATIONS
37-41 MARCY STREET, FREEHOLD, NEW JERSEY

NEW BOOKS

Synthesis of Electronic Computing and Control Circuits

BY THE STAFF OF THE COMPUTATION LABORATORY. *Harvard University Press, Cambridge, Massachusetts, 1951, 278 pages, $8.00.*

THIS book, published as Volume XXVII of the Annals of the Computation Laboratory of Harvard University, is a most welcome addition to the series.

The book deals entirely with digital computing circuits, considering no analog devices. (The reviewer is using the definition of digital computer published in *IRE Proceedings*, March 1951, page 273.) The control circuits mentioned in the title are of the type in which all of the relevant information is handled in digital form, rather than of the type associated with servomechanisms.

There are thirteen chapters and an appendix. The introduction (Chapter I) and the next six chapters deal principally with methods of deriving vacuum-tube circuits to perform specified logical functions, or switching functions as they are properly called here.

Computing circuits in electronic digital computers possess only a small number of states of energization. In a binary computer, this number is two, in that a computing circuit may only be energized or not energized. Basically, a switching function is an expression relating the state of energization of a given point in a computing circuit to the states of energization of a number of given points in some other computing circuits. The sets of states of energization of these given points are called the variables of the switching function. Vacuum-tube circuits which perform switching functions have been named vacuum-tube operators (Chapter II). With the possible exception of information-storage units as such, all information-handling parts of an electronic digital computer consist essentially of operators of this kind. Of course, this remains true regardless of the purpose of the information handled—whether it be computer control 'information or problem information—and regard-

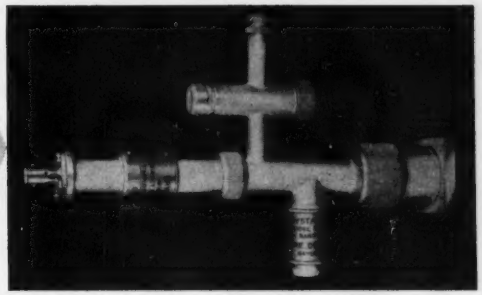
400%
MORE PRODUCT LISTINGS

...in the coming (Mid-June) electronics

BUYERS' GUIDE

than in any similar directory

COAXIAL CRYSTAL MIXER
BROAD BAND FIXED TUNED



Broad Band Crystal Mixer Model CM107

INPUT VSWR: Better than 2 to 1, without adjustments, for all frequencies within the nominal frequency range.

LOCAL OSCILLATOR POWER REQUIREMENT: 10 Milliwatts. Oscillator injector is adjustable to accommodate large variations in oscillator power.

LOCAL OSCILLATOR VSWR: Better than 2 to 1 with any L. O. injector adjustment.

LOCAL OSCILLATOR REJECTION AT I. F. OUTPUT: Better than 30 DB.

MODEL	FREQ. RANGE IN MC
CM-107A	225 to 400
CM-107A1	300 to 530
CM-107A2	510 to 760
CM-107B	750 to 1210
CM-107C	1120 to 1700
CM-107D	1700 to 2600

Other frequency ranges up to 5600 MC available.

EMPIRE DEVICES' expert engineering staff is available to give careful attention to your problems. Your inquiries are invited.

VISIT OUR BOOTH 349 AT THE IRE SHOW.

EMPIRE DEVICES, INC. 38-25 BELL BOULEVARD, BAYSIDE 61, N. Y.

MANUFACTURERS OF FIELD INTENSITY METERS • DISTORTION ANALYZERS • IMPULSE GENERATORS • COAXIAL ATTENUATORS

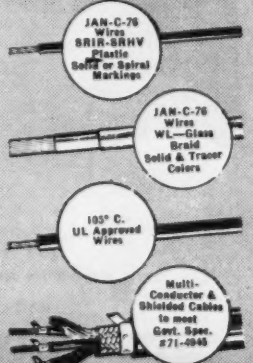
Specify BIRNBACH

WIRE & CABLE

for ALL your ELECTRONIC *wiring needs!*

GOVT. SPEC. HOOKUP WIRE

- **JAN-C-76 SRIR PLASTIC** Solid Colors or Spiral Markings
- **JAN-C-76 SRHV PLASTIC** Solid Colors or Spiral Markings
- **JAN-C-76 WL GLASS BRAID** Solid or Tracer Colors
- **105° UL APPROVED THERMOPLASTIC** Hookup Wire


JAN-C-76 Wires SRIR-SRHV Plastic Solid or Spiral Markings
JAN-C-76 Wires WL—Glass Braid Solid & Tracer Colors
105° C. UL Approved Wires
Multi-Conductor & Shielded Cables to meet Govt. Spec. #71-4045

COMPLETE WAREHOUSE STOCKS

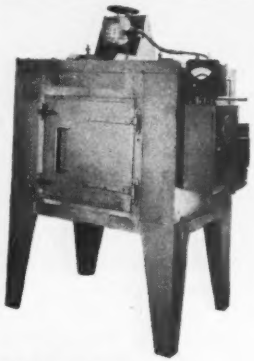
—Shielded Wires
—Multiconductor Rubber Covered Cables
—Tinned & Bare Wire
—Magnet Wire
—Vinyl Extruded Tubing
—Electronic Grade Tubing
—Aluminum Ground Wire
—Guy Wire
—TV Antenna Accessories
—Insulated Hardware
—Plugs, Jacks
—Insulators Steatite-Ceramic
—Terminal Strips
—Sockets
—Switches
—Test Leads

Write for Catalog 52-E

BIRNBACH

Quality Products for the Electronics Industries Since 1923

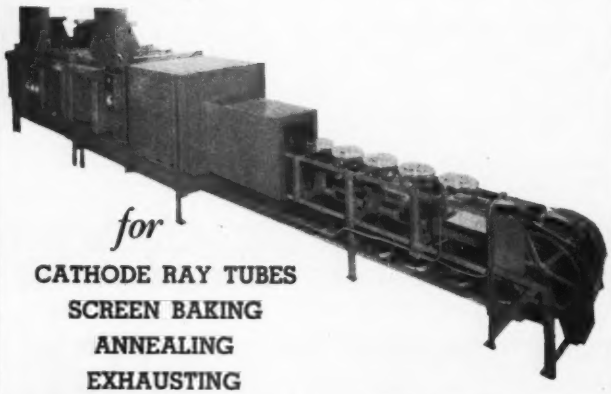
BIRNBACH RADIO CO. INC.
145 HUDSON STREET
NEW YORK 13, N. Y.



OVENS

Forced Air Circulation Cabinet Types, as illustrated, for glass annealing, coil baking, curing.

. . . . .



for

CATHODE RAY TUBES
SCREEN BAKING
ANNEALING
EXHAUSTING

MINIATURE TUBE
Button Stem Annealer
5391

We'll make it hot for you and you'll like it . . . .

WRITE, PHONE, or WIRE

STEINER-IVES COMPANY

16 AVENUE L NEWARK 5, NEW JERSEY

DESIGNERS AND BUILDERS OF INDUSTRIAL OVENS

Since 1889

less of whether this information be numerical or not.

Switching functions of two and three variables are discussed in detail in Chapter III. A vacuum-tube operator corresponding to each of all the possible switching functions of these variables is described which is believed to be minimal (containing a minimum number of control grids).

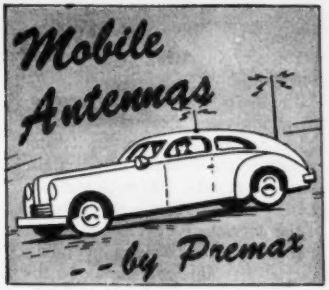
Switching functions of n variables are treated in Chapter IV and useful V.T. operators are also mentioned. Chapter V concerns minimizing charts, which are ingenious graphical devices for the determination of minimal V.T. operators. For small values of x, this technique is most useful. The authors point out, however, that the complexity of the charts increases quite rapidly with increasing x. They add: "The manipulation of functions of large numbers of variables, then, must await further theoretical development, and probably the construction of mechanical aids."

Chapter VI deals with pyramids and rectangles, circuits which produce 2" outputs from n inputs. Chapter VII treats multiple output circuits, outlining a number of helpful techniques.

With the exception of Chapter IX, which concerns time variables, and Chapter XI, which presents an interesting discussion of coding systems, the remainder of the book consists of an extensive treatment of the major computing components of digital computers. Triggers, rings and digit counters are discussed in Chapter VIII, rectifiers and associated circuits in Chapter X, while Chapters XII and XIII deal effectively with adders, accumulators and multipliers.

The Appendix contains a discussion and tabulation of the switching functions of four variables. A large number of clear illustrations appear throughout the book, and many well-chosen and instructive examples are given.

It is interesting to note that Boolean algebra is not explicitly used in this book. Instead, methods involving only common algebra are developed and used for the derivation of the results presented. As Professor Aiken points out in the preface, this procedure has the ad-



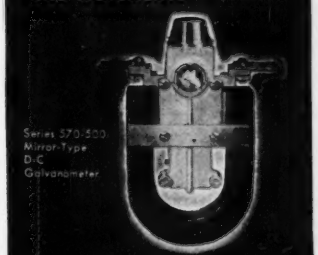
From 2 to 75 Meters

Tested and proven Antennas for the 1¼, 2, 6, 10, 11, up to 75-meter mobile installations —designed to increase the signal strength and yet offer low-cost equipment for amateurs and Civil Defense Corps.

Send for special Bulletin and prices.

PREMAX PRODUCTS
DIVISION CHISHOLM-RYDER CO. INC.
5201 Highland Ave., Niagara Falls, N. Y.

Specify... GM
D'ARSONVAL PORTABLE
GALVANOMETERS
AND MOVEMENTS...



Ideal as a built-in component of other instruments—with the sensitivity and ruggedness that is especially desirable for Colorimetry, Densitometry, and various other measurements. Unit includes mirror movement, magnet and zero correction knob. Choice of 4 standard models.

Write us about your application and requirements.

GM LABORATORIES, Inc.
4336 N. Knox Ave. • Chicago 41, Ill.

IN CANADA: COSSOR (Canada) LIMITED
301 Windsor St., Halifax, N. S.

---

you can count on *Laboratory Control...*

to bring you finer

PRECISION
COIL BOBBINS

Never-ending Laboratory Control of all materials assures you of Precision Bobbins that are lighter in weight, yet up to 20% stronger—better insulated bobbins that have more resistance to moisture and greater heat dissipation qualities. Increased coil winding space is a feature, too. Bobbins made round, square, rectangular; any ID, OD, length; of dielectric Kraft, Fish Paper, Cellulose Acetate or combinations.

Send for New Mandrel List of over 1,000.

★ ★ ★

PRECISION
PRECISION PAPER TUBE CO.
2041 W. CHARLESTON ST., CHICAGO 47, ILL.
Plant #2: 79 Chapel St., Hartford, Conn.
Also Mfrs. of Precision Paper Tubes

PRIMARY BATTERIES
for your Specialized Needs

DRY TYPES
78 Standard Industrial, Laboratory and Government Types.

LAB-BILT BATTERIES
Our engineers will design and create to your requirements. Send us your specifications.

RESERVE TYPES
Water activated "One Shot" Batteries.

HI-DRIVE MINIATURE MOTOR

Precision-built, low-cost, battery-operated — available only to manufacturers.

Send for FREE Catalog

SPECIALTY BATTERY COMPANY
A Subsidiary of the RAYOVAC Ray-O-Vac Company
MADISON 10, WISCONSIN

IN-RES-CO
TYPES SM-15 & SM-30 WIRE WOUND RESISTORS

SUB-MINIATURE
weather-tested midgets

Type SM-15 and SM-30 Resistors offer three vital advantages—sub-miniature size, weather resistant construction and high resistance. The elimination of center hole mounting and the inclusion of axial leads increases winding area and results in 25% greater resistance value than resistors of standard design. Special coating is moisture and fungus proof and designed to meet JAN-R-93 specifications. Sealed in Bakelite construction affords additional climatic protection. As ratings are conservative, types SM-15 and SM-30 can be specified with confidence for service under rigorous conditions.

TYPE SM-15
5/16" DIA. x 3/8" LG.

TYPE SM-30
5/16" DIA. x 3/4" LG.

ASK FOR THE NEW RESISTOR HANDBOOK – Contains complete data on resistors for every purpose and their recommended applications. Please make request on company letterhead.

INSTRUMENT RESISTORS CO.
COMMERCE AVENUE UNION NEW JERSEY

APPLICATION-DESIGNED RESISTORS FOR ELECTRONICS AND INSTRUMENTATION

IN-RES-CO
TYPES CX & BX WIRE WOUND RESISTORS

FEATHERWEIGHT!
—another IN-RES-CO solution for CIRCUIT DESIGNERS

SEALED IN MOLDED BAKELITE
PLUS LIGHTWEIGHT

The dependable resistive elements that combine positive sealing with the important advantage of lightweight. Molded Bakelite core reduces weight by one-half compared to ceramics. Positive seal effectively protects the winding against harmful climatic conditions. Additional IN-RES-CO features include long life stability, hard soldered connections to terminals and extra-sturdy, vibration proof terminal leads. Both CX and BX Resistors include space-saving terminal supported axial terminals of tinned wire.

IN-RES-CO
TYPE CX
NON-INDUCTIVE
RESISTOR

IN-RES-CO
TYPE BX
NON-INDUCTIVE
RESISTOR

ASK FOR THE NEW RESISTOR HANDBOOK – Contains complete data on resistors for every purpose and their recommended applications. Please make request on company letterhead.

INSTRUMENT RESISTORS CO.
COMMERCE AVENUE UNION NEW JERSEY

APPLICATION-DESIGNED RESISTORS FOR ELECTRONICS AND INSTRUMENTATION

vantage of involving only familiar concepts.

One feels, however, that mathematicians may, not unreasonably, object to this approach. Switching functions are Boolean polynomials, pure and simple. The exclusive use of the postulates of common algebra in the derivation of minimal forms of these polynomials may be unduly restrictive. More work may be involved and the results less widely applicable. For it should be noted that, insofar as the problems under discussion are concerned, the postulates of Boolean algebra are far more general, and hence, more powerful. In Boolean algebra, for example, the basic operations of union and intersection are both equally distributive; the duality laws permit the interchange of union and intersection in any valid expression.

But, since groups of transformations are involved, the methods of Boolean algebra may ultimately be insufficient anyway. When it appears, the derivation and proof of a completely general minimal representation will probably require broader techniques, such, perhaps, as those of lattice theory. In the meantime, Professor Aiken's formulation, together with his minimizing charts (for they are his own contributions), unquestionably produce results of real engineering significance and great practical usefulness.

The general aspects of the book conform in all respects to the high standards of the Harvard University Press. The typography and workmanship are excellent. The photo-offset printing process which is used insures that the number of typographical errors be reduced to a minimum. This reviewer has not found any and he does not expect to find any.

The material presented is well organized and clearly written. It is felt, however, that an index might be helpful. Further, the bibliographical references seem to be somewhat inadequate. Claude E. Shannon's well-known work is mentioned in the preface, but it does not seem that an explicit reference to his important contribution appears anywhere in the book, (A Symbolic Analysis of Relay and Switching Circuits, *Electrical En-*

Exclusives in the coming (Mid-June) electronics

BUYERS' GUIDE

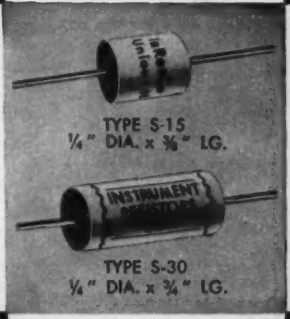
include:

- a cumulative editorial index to ELECTRONICS, 1940-1949 inclusive
- extensive trade name listings
- geographical listings of distributors
- simple telephone book type product listings

sub-miniature AND moisture-proof

IN-RES-CO S-15 & S-30 WIRE WOUND RESISTORS

THE ECONOMICAL SOLUTION where moisture proof resistive elements of comparatively small size are required for commercial applications. Type S-15 is ⅜" long by ¼" diameter; type S-30 measures ¾" by ¼" diameter. Both types are moisture proof and capable of high performance over long periods of continuous service. IN-RES-CO Resistors for every ordnance or civilian requirement are available at a cost that solves circuit design problems both performance-wise and cost-wise. Check up now, on the complete line of IN-RES-CO quality wire wound resistors.



INSTRUMENT RESISTORS CO.
COMMERCE AVENUE UNION NEW JERSEY

FOR JAN SPECIFICATION RESISTORS — consult the new illustrated literature describing the complete in-res-co line. Write for your copy today!

APPLICATION-DESIGNED RESISTORS FOR ELECTRONICS AND INSTRUMENTATION

SPACE SAVERS FOR MODERN CIRCUITRY — MONEY SAVERS FOR PRODUCTION ECONOMICS —

IN-RES-CO TYPE IR WIRE WOUND RESISTORS

The practical, low cost solution for circuit designers striving for the subminiature. Type IR units offer precision resistance values capable of retaining stability through long periods of continuous or intermittent service. Type IR resistors are available at prices based on mass production methods of manufacture. Wound to a tolerance of ±1%, they are permanently accurate. Conservative ratings allow ample safety margin in all classes of service. Special Bakelite forms eliminate shrinking, swelling and temperature effects. IN-RES-CO moisture and fungus proof coating offers absolute protection against climatic extremes. Specify IR Type resistors for all applications where precision performance and limited space are important determining factors.

INSTRUMENT RESISTORS CO.
COMMERCE AVENUE UNION NEW JERSEY

WRITE FOR NEW RESISTOR HANDBOOK — Contains complete data and recommended applications for resistors for every purpose.

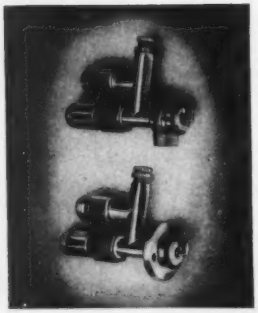
APPLICATION-DESIGNED RESISTORS FOR ELECTRONICS AND INSTRUMENTATION

MICROWAVE
EQUIPMENT

MANUFACTURERS
OF
PRECISION
EQUIPMENT
SINCE
1942

MICROWAVE TRANSMISSION
COMPONENTS
AND SPECIALIZED ELECTRONIC
ASSEMBLIES

- DUPLEXERS
- ROTATING JOINTS
- DIRECTIONAL COUPLERS
- CRYSTAL MIXERS
- FEEDHORNS
- MAGNETRON COUPLERS
- PHASE SHIFTERS
- OSCILLATING JOINTS
- BROADSIDE ARRAYS
- DOUBLE-STUB TUNERS
- CAVITIES
- WAVEGUIDES
  —AND SPECIAL DESIGNS



Top Photo
10 cm.
Duplexer

Center Photo
Crystal
Mixers

Bottom Photo
Antenna
Feedhorn

Inquiries invited regarding manufacture, development and calibration of any microwave units.

BOGART MANUFACTURING CORP.
315 SIEGEL STREET
BROOKLYN 6, NEW YORK
Phone: HYacinth 7-4972

gineering, Transactions Supplement, 1938, p 713).

But these are minor details. The book is highly recommended. Engineers engaged in the development of any digital information-handling equipment, whether strictly for computation purposes or not, should find it most useful. It should be useful also to mathematicians working in abstract algebra—at least to those who are interested in learning what computer engineers expect of them. The authors should be congratulated for this addition to an already long list of solid achievements. — ROBERT SERRELL, *RCA Laboratories Division, Princeton, New Jersey.*

Ferromagnetism

BY RICHARD M. BOZORTH, *Technical Staff Member, Bell Telephone Laboratories. D. Van Nostrand, New York*, 1951, 968 *p*, $17.50.

IN THIS, the most complete work of its kind ever published, Dr. Bozorth has presented to engineers and physicists a most sorely needed central clearing house for information on ferromagnetism and ferromagnetic materials. The book is not a rehash of the principles of electricity and magnetism to be found in any good textbook on the theory of electromagnetism. Indeed, the author touches upon such matters only to the extent that they are necessary to the complete explanation of present-day understanding of the mechanics of ferromagnetism. While it is a reference work rather than a textbook, it will be as valuable to the student and physicist as it is to the practicing engineer since the author presents the theoretical and practical aspects of his subject with equal emphasis.

After an introductory chapter defining and describing those fundamental concepts of magnetism that are relevant to ferromagnetic theory, the first half of the book is devoted to the materials involved—their history, their methods of manufacture, and their physical, metallurgical, mechanical and magnetic properties.

Greatest emphasis is quite properly placed upon the iron, nickel and cobalt alloys and particularly upon

for EMERGENCY

for CONVENIENCE

SOUND POWERED
INTERCOM and TEST
SYSTEMS

by
WHEELER

- No auxiliary power is required
- Operates over two conductor full metallic or single wire, ground return circuit
- Satisfactory operation up to 25 miles with #16 twisted, up to 15 miles with #19 twisted
- Explosion proof
- No spark or fire hazard is generated
- High fidelity speech transmission
- 12 handsets can be incorporated in communications system for group conversation

Write For NEW Catalog E-100
And Industrial Price List.

Distributed by

Digby 9-1132-3-4

Niagara RADIO SUPPLY CORP. Dept. 3-E

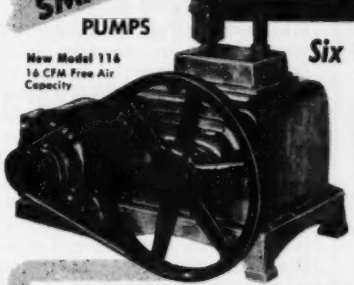
ONE OF AMERICA'S GREAT RADIO STORES

160 Greenwich Street, New York 6, N. Y.

FOR FASTER PUMPING
WITH SMALLER PUMPS

INTERNATIONAL
HIGH VACUUM
COMPOUND PUMPS

New Model 116
16 CFM Free Air
Capacity



Six Ways a Better Pump:

1. SIMPLIFIED CONSTRUCTION
2. ROTARY VANE
3. AUTOMATIC LUBRICATION
4. HIGH EFFICIENCY
5. QUICK RECOVERY
6. RUGGEDLY BUILT

Speed production and reduce maintenance with these ready-to-operate, high efficiency vacuum pumps!

International rotary vane pumps are extremely compact and operate unusually quiet. Simplified construction and automatic lubrication assure trouble-free operation, long life and low-cost upkeep. Pump mechanisms are totally oil submerged, preventing atmosphere to vacuum leakage.

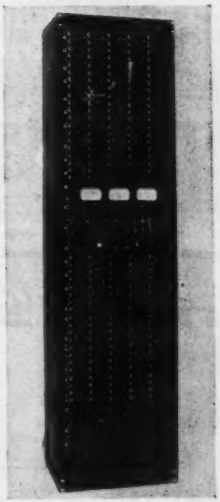
CAPACITIES UP TO 30 C.F.M.
WRITE FOR LITERATURE TODAY

International Pump & Machine Works
PUMP DIVISION
11-13 GOVERNOR STREET
NEWARK 2, NEW JERSEY

SPECIALIST MANUFACTURERS OF INDUSTRIAL GRADE WORKING MACHINERY AND HIGH VACUUM PUMPS FOR ELECTRONICS, NUCLEONICS AND RESEARCH FOR OVER A QUARTER CENTURY

FIRST
COMMERCIAL
100
VACUUM TUBE
*AGING RACK
TYPE 242

Any Standard VOLTAGE
with
Any Standard LOAD
on
Any Tube ELEMENT

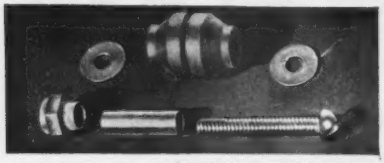


* Complies with Service aging requirements for reliability testing vacuum tubes.

- Power supplies regulated and continuously variable.
- 500 to 1000 watts for both filament and plate power.
- Bias voltage 0 to 75 volts at 0 to 50 mils.
- Flexible patching permits changing tube types in banks of ten in less than 2 minutes per bank.
- Safe for continuous operation. Furnished with reliable production type sockets.

PENNSYLVANIA
TESTING
LABORATORY
Doylestown, Pa.

Try Remler for Service-Tested "Hard-to-Get" Components



SILASTIC RUBBER SHOCK MOUNTS

① Ideal for sub-panel mounting Isolates tubes from shock and vibration. Mount retains compliance from *minus* 70° to *plus* 480°F. Invaluable for military and airborne equipment.

MINIATURE TUBE CLAMP

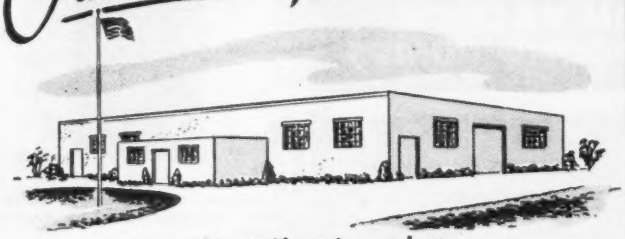
② Corrosion resistant. Holds miniatures in sockets under severe conditions of shock and vibration without restricting air circulation. Easy to insert and withdraw tubes. Three sizes.

Custom Components
Metal-plastic components designed and manufactured to order. Write for quotations specifying electrical and mechanical characteristics. Describe application. No obligation.

Remler Company Ltd.
2101 Bryant St. San Francisco 10, Calif.

Remler
Since 1918 PIONEERS IN ELECTRONICS AND PLASTICS

Announcing OUR NEW HOME!



Our New Plant is ready to meet the increasing demand for

PULSE EQUIPMENT
General Purpose and Special Pulse Generators

SUB-CONTRACT FACILITIES
for Engineering and Manufacture of Electronic Equipment

LOOK US UP AT BOOTH 422 I.R.E. SHOW GRAND CENTRAL PALACE

Inquiries invited

TELETRONICS LABORATORY INC.
WESTBURY, L. I., N. Y.
MANUFACTURERS OF ELECTRONIC INSTRUMENTS AND PRODUCTION TEST EQUIPMENT

the iron-nickel system because of the great importance of all these alloys in modern engineering work. However, practically all alloys, of whatever composition, that were ever detected to have exhibited ferromagnetic characteristics have been included and described to the best of existing knowledge. This round-up of far-flung information on flux-carrying materials will be of the greatest value to the design engineer working on transformers or relays or motors or permanent magnet assemblies,—or any of the thousands of other applications involving their use. The serious research worker in such materials will find it mandatory to acquaint himself with the work of others through the complete coverage of such information in this portion of the book.

The second half of the book discusses fully the modern theory of ferromagnetism. The basic causes of the phenomenon are presented in terms of the atomic interactions which produce it. The effect of Ewing's theory, the Weiss theory and quantum theory on modern domain theory is fully explained and the theory itself is used in the discussion and explanation of such age-old mysteries as saturation, residual induction, coercive force, hysteresis, the shape of the magnetization curve, the Barkhausen effect, permeability and anisotropy. The theories of paramagnetism and diamagnetism are presented and a very large chapter is devoted to the increasingly important subject of magnetostriction. The Curie Point of materials and the energy of magnetization are considered as well as such lesser known quantities as the magnetocaloric effect, the magnetoresistance effect, change of magnetization with time and antiferromagnetism. A chapter on permanent magnets embraces a consideration of their design as well as a detailed discussion of the metallurgy and properties of the numerous commercially available alloys. The book is concluded with a presentation of the methods of magnetic measurements.

A total of 825 figures and drawings and 96 tables serve to illustrate the text and present the reference data in a most convenient and un-

400%

MORE PRODUCT LISTINGS

...in the coming (Mid-June) electronics

BUYERS' GUIDE

than in any similar directory

FOR FREQUENCY

Stability

IN

Mobile

EQUIPMENT . . . .

make sure your crystals are made by Standard Piezo.

For years, our Crystals have been standard as original equipment with leading manufacturers and for replacement purposes by large operators of mobile equipment.

Precise, accurate, Standard Piezo Crystals are available for *ALL* types of mobile communication equipment.

Request catalog E for complete details.

Standard Piezo
COMPANY
CARLISLE, PENNSYLVANIA

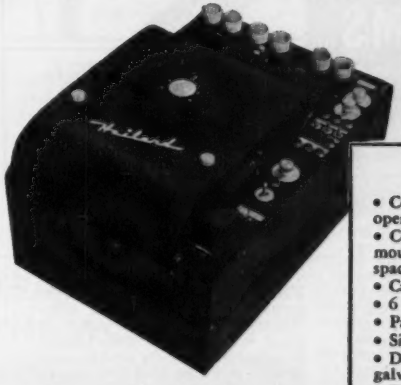
Completely Accessible

from operating surface

dependable instruments

Heiland
DENVER

Type A-708...24-channel



AUTOMATIC OSCILLOGRAPH RECORDER

Affording complete accessibility from operating surface and requiring only a minimum of space for mounting, the HEILAND A-708 meets the exacting specifications of research and development personnel in aircraft flight testing, laboratory and industrial testing.

Write for complete details

FEATURES

- **Completely accessible from operating surface**
- **Compact...can be mounted in a minimum of space...lightweight**
- **Can be panel mounted**
- **6 to 24 channels**
- **Paper widths 5", 8", 12", 18"**
- **Simplicity of loading**
- **Direct monitoring of galvonometer light spots**
- **Flexibility of operation**
- **Simultaneous viewing, recording and scanning**
- **Trace identification...zero mirror...synchronizing reference trace**
- **Adjustable automatic record length**

HEILAND RESEARCH CORPORATION · 130 East Fifth Ave. · Denver, Colo.

Simplifying **HF** *Power Measurement*

Model 67 **TERMALINE**

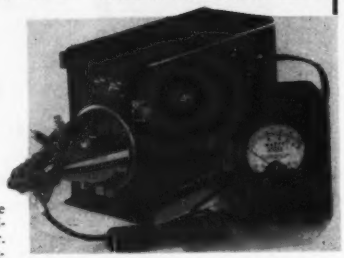
DIRECT-READING R-F WATTMETER

30 mc to 500 mc
(to 1000 mc if specified)

50 ohms

Triple Range 0-25 watts
0-100 "
0-500 "

Type N Input Connector
(Adapter for PL-259 supplied)



● Model 67 is a larger type Wattmeter than the well-known AN-ME-11/U (our Model 611) R-F Wattmeter. Specifically designed for fixed-station transmitters to 500 watts output, it may be used nicely on low range for mobile gear. Provided with an aluminum cased, shock-mounted meter, Model 67 is as simple to use as a DC voltmeter. Now in general use throughout the industry, TERMALINE Wattmeters may be depended upon for fast, accurate and repeatable power readings.

NON-RADIATING
... Accuracy — 5%

RUGGED CONSTRUCTION
... Size — 17" x 9" x 6"
Wght. — 30 pounds

BIRD
ELECTRONIC CORP.
TERMALINE COAXIAL LINE INSTRUMENTS

1800 EAST 38TH ST.
CLEVELAND 14,
OHIO

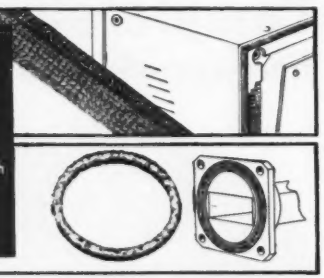
West Coast:
NEELY ENTERPRISES
HOLLYWOOD 46, CAL.

SHIELDING PROBLEMS

effectively and economically solved with

METEX

electronic "Weather Strips"



Resilient... Conductive... Compressible... Cohesive

From closures for cabinets to gaskets for waveguide couplings, Metex Electronic Shielding assures *lasting* metal-to-metal contact to prevent leakage, without the need for costly machining to secure precise surface-to-surface contacts. Metal wire — *knitted*, not woven or braided — gives Metex Electronic Strips and Gaskets that combination of conductivity and resiliency which makes them so effective and economical for shielding.

For a more detailed picture of the scope of utility of Metex Electronic Products, write for free copy of "Metex Electronic Weather Strips." Or outline your specific shielding problem—it will receive immediate attention.

METAL TEXTILE CORPORATION
KNITTERS OF WIRE MESH FOR MORE THAN A QUARTER CENTURY

METEX

641 East First Avenue **Roselle, N. J.**

derstandable form. A means is provided for the more serious student to pursue any particular aspect of the subject through a bibliography of 1,777 references, all completely cross-indexed to the text. This is probably the most complete collection of references to magnetic information ever assembled. A carefully prepared subject and author index makes the location of material easy.

Compiled by one of the country's most outstanding experts on magnetic materials, the book is not only authoritative and comprehensive but its language is interesting and understandable with mathematics maintained to a minimum. It definitely is a must for every engineer and company librarian engaged in the electrical industry.—EARL M. UNDERHILL.

Theory and Design of Television Receivers

BY SID DEUTSCH. *McGraw-Hill Book Co., New York*, 1951, 536 *pages*, $6.50.

THIS book attempts to fill the need for an engineering text on the theory and design of television receivers. On the whole it falls short of achieving this objective. Its most serious fault is the not infrequent distortion of established principles; in many instances inaccurate statements are made which might be accepted as authoritative by relatively inexperienced readers. Because many of the circuits shown are not representative of commercial practice, the utility of the book is impaired.

In choice of subject matter and distribution of emphasis the book leaves much to be desired. It oscillates in technical level between (a) the vocational-school level as exemplified by beating an 8-cycle and 10-cycle wave to illustrate the principles of frequency conversion and (b) a highly mathematical level as exemplified by the use of the Laplace transform. Many items of importance are omitted; and others such as elementary geometrical optics, which might better have been omitted, are treated in excessive detail.

The omission of bibliographic references, in a text which attempts to meet the needs of senior and

Exclusives in the coming (Mid-June) electronics

BUYERS' GUIDE

include:

- **a cumulative editorial index to ELECTRONICS, 1940-1949 inclusive**
- **extensive trade name listings**
- **geographical listings of distributors**
- **simple telephone book type product listings**

RMB offers PRECISION QUALITY
EXTRA LIGHT RADIAL BEARINGS

for Computors, Servo mechanisms, Potentiometers and similar exacting applications

For light loads, low torque, high sensitivity, use R.M.B. Extra Light Ball Bearings — designed specifically for this purpose.

COMPARE THESE TYPICAL RELATIONSHIPS:

No.	Bore	O.D.	Width
205	.0787"	.1969"	.0591"
409	.1575	.3543	.0984
714	.2756	.5512	.1378
1019	.3937	.7480	.1772

There are 8 additional stock sizes in this series.

Write today for Catalog, Price List and Substantial Quantity Discounts

Good Deliveries — Experimental Quantities from Stock

LANDIS & GYR, INC.
45 West 61 Street, New York 19, N. Y.

FS MICROMETER HEAD
for the Electronics Industry

ENGINEERS USING FS MICROMETER HEADS FOR VARIOUS APPLICATIONS FIND THE TEMPERATURE COMPENSATION CONSTRUCTION AND AUTOMATIC COMPENSATION FOR WEAR OF SPINDLE AND NUT THREAD CONTRIBUTING FACTORS TO THE INSTRUMENT'S PRECISE ACCURACY . . . A DEGREE OF ACCURACY IN READING, HITHERTO UNATTAINABLE IN ANY MICROMETER HEAD. SEND TODAY FOR YOUR COPY OF THE NEW DESCRIPTIVE BULLETIN.

FREQUENCY STANDARDS
P O BOX 66 EATONTOWN N J • TELEPHONE ASBURY PARK 1 1018

TRIED and PROVEN THE WORLD OVER

Lettine Model 240 Transmitter with Mobile Connections and A.C. Power Supply

This outstanding transmitter has been acclaimed a great performer throughout the world. It is excellent for fixed station, portable or mobile operation.

The 240 is a 40 watt transmitter for CW and plate modulated Phone operation, operating on any frequency from 1.8 to 30 mc.; complete with self contained 115 volt A.C. power supply, mobile connections, meter, (8 x 14 x 8) cabinet and tubes: 6V8 osc., 807 final, 6SJ7 crystal mike amp., 6N7 phase inverter, 2 6L6's mod., 5U4G rect. Weight 30 lbs. 90 day guarantee. Also used on 160 to 10 meter Amateur bands.

PRICE: less coils and crystal $76.55
Coils for any one freq. from 1.8 to 3.5 mc. . $3.60
Coils for any one freq. from 3.5 to 30 mc. . $2.91

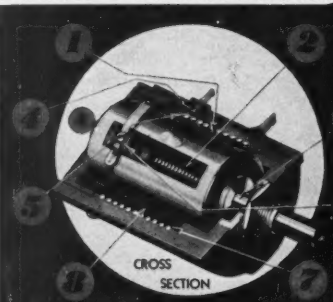
Send order to:

LETTINE RADIO MFG. CO.
62 Berkley St. Valley Stream, N. Y.

MICROPOT

PRECISION TEN-TURN POTENTIOMETER

1. You get permanent accuracy because the resistance wire is locked in place. It is precision positioned and moulded integrally with the housing.
2. You get permanently accurate settings, smooth action and low uniform torque provided by the stainless steel, precision ground, double thread lead screw guiding the moving contact.
3. You get precise positioning of the moving contact because of the two bearings supporting the rotor assembly.
4. You get good rigid terminals because they are moulded integrally with the housing.
5. Terminals soldered to ends of resistance element before moulding. Entire resistance circuit is an integral part of the housing.
6. You get accurate setting and resetting due to anti-backlash spring in contact guide.
7. You get a fine resolution because of the 43½" length of resistance wire in the spiral element.
8. You get a resistance output directly proportional to shaft rotation within ±0.1% of the total resistance. Every potentiometer is automatically machine tested for linearity at 101 points.



LINEARITY ACCURACY ± 0.1%

Units for immediate shipment:
1,000 to 30,000 ohm range.
Special resistance values made to order.

WRITE TODAY FOR ENGINEERING INFORMATION

BORG EQUIPMENT DIVISION
THE GEORGE W. BORG CORPORATION
JANESVILLE • WISCONSIN

NWL

Nothelfer

SPECIALISTS IN TRANSFORMERS

NOTHELFER
WINDING LABORATORIES
9 ALBERMARLE AVE. TRENTON 3, N. J.

graduate engineering students as well as professional engineers, is difficult to justify. In this text of over 500 pages there are some 11 references, yet there are many instances where appropriate easily available references would have been invaluable.

This book covers a broad subject in a rapidly changing field and represents a difficult project for any one engineer to handle adequately. It is unfortunate that the several sections of the manuscript were not checked before publication by engineers expert in their individual specialties.—JACK AVINS, *Industry Service Division, Radio Corporation of America*

Industrial High Frequency Electric Power

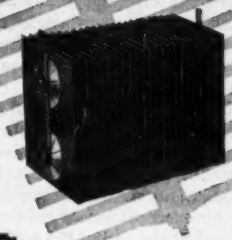
BY E. MAY. *John Wiley and Sons, New York*, 1950, 355 *pages*, $5.00.

IN THE 350 pages of this book the reader will find a surprising amount of useful information. Although the title does not mention induction or dielectric heating, this is really the subject with which the book deals in a very comprehensive and capable manner. The book has the great advantage that the reader will not have to refer to a lot of other books; it starts with some 50 pages of basic circuit theory, which gives an excellent foundation for what follows. The next 110 pages are devoted to a description of sources of high-frequency power (where by "high" is meant anything higher than the usual power-line frequencies). Treated are arc and spark oscillators, inverters, rotating high-frequency alternators and oscillators using power tubes; the treatment is in sufficient detail to be useful even to the designer of such equipment.

The next 80 pages are devoted to the theory of induction and dielectric heating. The industrial engineer will find this section particularly valuable, because it contains a collection of a great number of formulas and graphs enabling him to decide whether this type of heating will be suitable for a particular application he may have in mind. Data on optimum frequencies for hardening or for through heating,

SYNTRON

SELENIUM RECTIFIERS



Made by a new process to a uniform, high quality for continuous, heavy-duty service.

1" sq. to 12"x16" cells—in stacks, or single cells for customer assembly.

Write For Illustrated Folder

SYNTRON CO.

241 Lexington Homer City, Pa.

MICRODIAL

TEN TURN-COUNTING DIAL

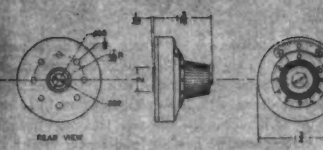
Microdial is composed of two concentrically mounted dials . . . one for counting increments of each turn and the other for counting turns. The incremental dial has 100 equal divisions and is attached rigidly to the shaft so there is no backlash. Thus the contact position is indicated to an indexed accuracy of 1 part in 1000. Rotation is continuous in either direction. There are no stops on the Microdial assembly.

COMPACT . . . Microdial has same O.D. as Micropot . . . requires no more panel space.

CLEAR READING . . . Forced fast-reading tests showed only 1/20th as many errors with Microdial open window as with next most legible dial. Turn counter distinguishes between 0 and 10 turn readings, and accelerates to avoid confusion on readings near integral turns. Precise readings are made from larger dial with maximum separation of graduations and wide angle visibility.

CONVENIENT . . . delivered completely assembled with dials synchronized. Easily mounted in a few seconds. All dials may be locked.

ACTUAL SIZE



REAR VIEW

Microdial . . . turn-counting dial, primarily designed for use on Micropot ten turn linear potentiometer . . . can be on any multiturn device having ten turns or less.

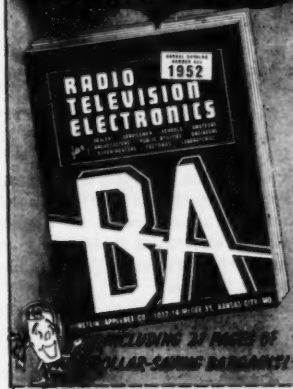
BORG EQUIPMENT DIVISION

THE GEORGE W. BORG CORPORATION

JANESVILLE • WISCONSIN

DID YOU GET IT? IF NOT

SEND NOW FOR B-A's 136 BIG PAGE FREE CATALOG



INCLUDING 24 PAGES OF DOLLAR-SAVING BARGAINS!

BURSTEIN-APPLEBEE CO.
1012-14 McGee St.
Kansas City 6, Mo.

FREE

Send your 1952 catalog to:

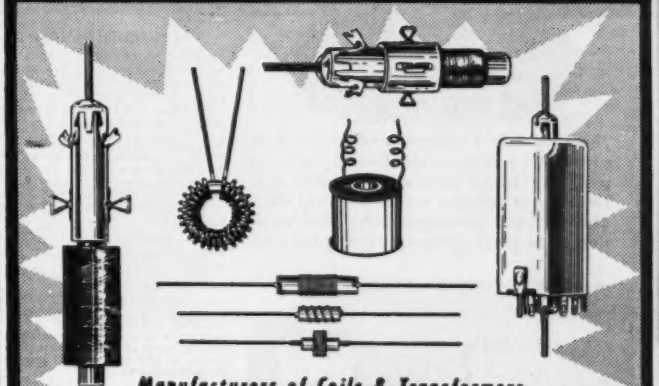
Name.....

Address.....

City..... State.....

BURSTEIN-APPLEBEE CO.

HILLBURN



Manufacturers of Coils & Transformers

- I. F. Coils and Transformers
- Linearity and Size Coils
- Peaking Coils and Plate Chokes
- Loading Coils • Toroids • Bobbins
- Solenoid, Universal, Random and

Space Winding to Commercial or Military Specifications

HILLBURN ELECTRONIC PRODUCTS, 55 NASSAU AVE., BROOKLYN 22, N. Y.

It's rpc

for
Precision
Wire Wound Resistors

RPC Resistors are high quality units designed to meet the most stringent requirements. They are widely used in large quantities by laboratories, instrument manufacturers, and the Armed Forces and their suppliers. Sizes available are in accordance with JAN-R-93, RB10 to RB14 and RB51. Terminals may be wire leads if required. Resistance tolerance to 0.02% is available. All resistors are treated against humidity and fungus growth.

Write today for catalog.

Also manufacturers of High Voltage Resistors, High Megohm Resistors and High Frequency Resistors.

rpc RESISTANCE PRODUCTS CO.
714 RACE STREET • HARRISBURG 2, PA.

MODEL 204A REGULATED POWER SUPPLY

0-500 VOLTS D.C. AT 300 MA. WITH POSITIVE OR NEGATIVE GROUND

The Model 204A Regulated Power Supply will provide from 0-500 volts of well regulated and well filtered D.C. The output voltage is continuously variable without switching and either positive or negative side may be grounded.

SPECIFICATIONS:

OUTPUT VOLTAGE
High Voltage: 0-500 Volts D.C. continuously variable (Without switching).
Current: 300 Ma.
Low A.C. Voltage: 6.3 Volts A.C. at 6 amps. center-tapped, unregulated.

REGULATION
Within 1% for voltage between 30-500 volts, from no load to full load.
Within 1% for line voltage variations from 105 to 125 volts at full load current for any voltage between 30-500 volts and within 2% at 10 volts.

HUM VOLTAGE
Within 10 Millivolts at any voltage or load within ratings.

LINE INPUT
105-125 Volts A.C. 50-60 cycles.

OUTPUT TERMINATIONS
High and low voltage outputs available from front and rear of unit. Positive or negative terminal of high voltage output may be grounded as desired.

Detailed specifications will be forwarded upon request without obligation.

E/M
ELECTRONIC MEASUREMENTS COMPANY
RED BANK • NEW JERSEY

speed of heating, and power consumption to be expected are given.

The remaining 100 pages are devoted to auxiliary equipment, methods of measurements and the description of commercially available induction and dielectric heating equipment. It should be mentioned, however, that whenever equipment is described, the author confines himself to British apparatus. Some readers may consider this a shortcoming, but in view of the great amount of useful theoretical material, this is a small matter indeed.

An excellent list of references is found at the end of the book.

The title indicates that no information will be found on the application of low-frequency power to induction heating. In recent years 60-cycle power has been used successfuly for the heating of large billets, and the addition of a chapter on this subject might have been welcomed by many readers. This is again of minor importance.

This book should prove a welcome addition to the library of any electrical engineer involved or interested in induction or dielectric heating.—WALTHER RICHTER, *Consulting Electrical Engineer*

The Measurement of Radio Isotopes

BY DENIS TAYLOR. *John Wiley & Sons, New York*, 1951, 118 *pages*, $1.50.

IN ANOTHER of the Methuen monographs on physical subjects, Dr. Taylor, head of the electronics division of the Harwell atomic energy establishment, has written a handy and useful treatise on the application of electronics to detecting and measuring radiation from radioactive isotopes.

Since it is written for the non-expert, the book makes an excellent first approach to the subject. The mathematics is not too difficult and can be neglected at first reading anyway. After a review of the fundamental facts of how the activity of these isotopes change with time and, therefore, how the instantaneous activity can be measured, the author describes how the several types of radiation are detected. G-M tubes, ionization chambers, electro-

400%

MORE PRODUCT LISTINGS

...in the coming (Mid-June) electronics

BUYERS' GUIDE

than in any similar directory

MAGNETIC AMPLIFIERS·INC

Visit us at the IRE SHOW BOOTH #460

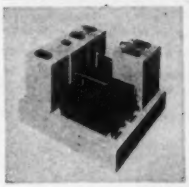
Affiliate of GENERAL CERAMICS & STEATITE CORP.

11-54 44th DRIVE, LONG ISLAND CITY, NEW YORK • TEL. STILLWELL 6-2191

PACKAGED PUSH-PULL MAGNETIC AMPLIFIERS 60 and 400 CPS and higher

SATURABLE TRANSFORMERS AND REACTORS 60 and 400 CPS 1 W to 1 KW

VOLTAGE CURRENT FREQUENCY MOTOR SPEED REGULATORS



MAGNETIC MODULATORS DEMODULATORS TOROIDAL WINDINGS

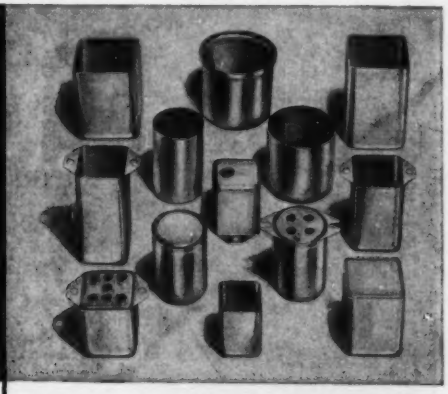
AMPLIFIERS AND COMPONENTS FOR:

AIRCRAFT • GUIDED MISSILES • ARMAMENT • NAVAL INSTALLATIONS • ATOMIC ENERGY • INDUSTRIAL CONTROL • RADAR INSTALLATIONS • TEST EQUIPMENT

Write to Us for Engineering Proposals on Your Specialized Requirements

---

drawn cases

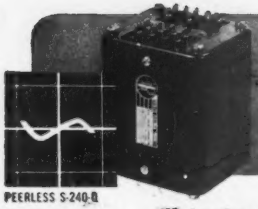


also
OLYMPIC
Fabricated cases
End shields
Channel frames
Mounting brackets

hot tin dipped . . . fabricated terminal and vent holes . . . smooth, one-piece construction using cold rolled steel . . . draw depths up to 2½" . . . inside fit covers for easy hermetic sealing in all sizes . . . available as stock sizes and as special fabrications.

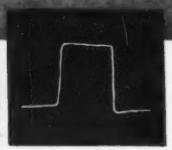
OLYMPIC METAL PRODUCTS COMPANY, INC.

P. O. BOX 71A **PHILLIPSBURG, N. J.**



PEERLESS S-240-B

If you "talk test"... you talk Peerless



Square Wave

all tests demonstrate **PEERLESS** superiority

Competitor No. 1

Competitor No. 2

Competitor No. 3

Competitor No. 4

Comparative square wave tests on transformers shown all over the country have demonstrated Peerless superiority... Now Peerless emphasizes another very important property of transformers as shown by the "exciting current test." An output transformer's ability to deliver plenty of clean, low-frequency power (the goal of every music lover) is inversely proportional to the amplitude and distortion of its exciting current.

PEERLESS superior low-frequency power handling capacity is illustrated in these comparative oscillograms.

Write for complete data.

PEERLESS
Electrical Products

9356 Santa Monica Blvd.
Beverly Hills, Calif.

161 Sixth Avenue
New York 13, N.Y.

Division
ALTEC
LANSING CORPORATION

Measure Time Intervals

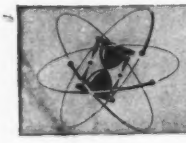
From 10 Microseconds to 3 Seconds

The time interval between any two components in electrical, mechanical or electro-mechanical systems can *now* be measured, *simply* and *accurately*, with American Chronoscope Equipment.

The Model 211 Input Adapter used in conjunction with the Model 110 American Chronoscope separates the functions of STARTING and STOPPING the measurement of time. Simply connect the Start and Stop leads from the adapter to any two components of a system under test. Only the first complete elapsed time interval presented is accepted. This reading is indicated on the Chronoscope and remains fixed until reset.

PRICES
Model 110 Chronoscope $475
Model 211 Input Adapter . . . $265

For complete description on these and other Chronoscopes and Adapters, write for Bulletin 200 A



American Chronoscope
CORPORATION
316 WEST FIRST ST. MOUNT VERNON, N. Y.

meters and all the accessory electronic counting and scaling equipment are covered in a lucid manner.

A chapter on statistics, another on the effect of source geometry on the accuracy of measurement, and some words on the correction factors that enter into quantitative measurements are followed by a final chapter on health hazards and radiation monitors, thus rounding out a very useful text on the general subject.—K.H.

THUMBNAIL REVIEWS

BROADCAST OPERATOR'S HANDBOOK, Second Edition. By Harold E. Ennes, staff engineer, WIRE. John F. Rider Publisher, Inc., New York, 1951, 440 pages, $5.40. General revision plus new material for the man in the control room or studio, at the master control, outside the studio on remote pickups, or at the transmitter. Problems of emergency shutdowns, descriptions of equipment, measurement techniques etc.

ADVANCED THEORY OF WAVEGUIDES. By L. Lewin. Iliffe & Sons, Ltd., London, 1951, 192 pages, 30 shillings. Selected topics in waveguide theory for the reader already familiar with essentials and practice and with good working knowledge of advanced mathematics. Seven chapters:—electromagnetic theory and its application to waveguides, cylindrical posts, diaphragms, tuned post and tuned window, waveguide steps, T's and tapers, radiation from waveguide and propagation in loaded and corrugated guides.

TABLES OF THE ERROR FUNCTION AND OF ITS FIRST 20 DERIVATIVES. From the computation staff, Harvard University. Harvard University Press, Cambridge, Mass., 1952, 276 pages, $8.00. New 6-place tables of the error function and derivatives on a finer mesh, with more extensive range, with higher derivatives than heretofore published together with areas and ordinates.

BASIC ELECTROTECHNICS. By B. L. Goodlet. Sometime professor of electrical engineering, Universities of Cape Town and Birmingham. Edward Arnold & Co, London, Longman, Green and Co., Inc., 55 Fifth Ave., New York, 1951, 247 pages, $4.00. Elementary electromagnetic theory for beginners and for students who have some knowledge of physics and calculus. Contents:—steady electric currents, electrostatic fields, capacitors and dielectrics, electrodynamics, calculation of magnetic fields, alternating currents, Maxwell's equations.

AN INTRODUCTION TO ACOUSTICS. By Robert H. Randall, associate professor of physics, City College of New York. Addison-Wesley Press, Inc., Cambridge, Mass., 340 pages, 1951, $6.00. For undergraduates in physics or engineering students who may wish later to specialize in acoustics. From fundamental particle vibration theory to speech and hearing, sound measurements, reproduction of sound and applied acoustics.

SYMPOSIUM, LARGE-SCALE DIGITAL CALCULATING MACHINERY. 1951 Harvard University Press, 393 pages, $8.00. Proceedings of the second symposium sponsored by the Navy Department, Bureau of Ordnance and Harvard, held at the Computation Laboratory, 13-16 September 1949, including speeches, discussions and papers on recent developments in computing machinery, numerical methods, computational problems in physics, aeronautics and applied mechanics, economic and social sciences and the future of computing machinery.

OFFICIALLY APPROVED
by the Nation's Foremost
ELECTRONIC MANUFACTURERS!

ANCHOR

★EXCEEDS ASTM Specifications

★Conforms with JAN(AN-S-62) Specifications

Activated Rosin-Core SOLDER

The SHURFLO Rosin: Speeds up solder flow 25%. Spreads as much as 30% further than ordinary rosin. Has superior wetting and oxide-removing action. Is non-corrosive, non-conductive, safe. Gives no unpleasant odor. Does not carbonize.

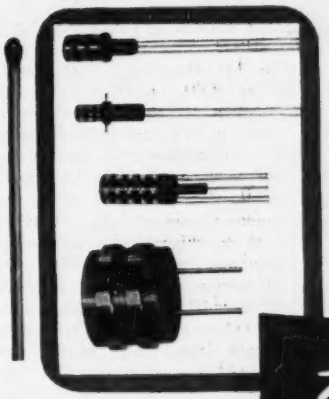
Specially designed for all electronic needs. Makes perfect joints to common and difficult metals. 30% more economical to use. Supplied in 1, 5, 20 lb. spools—gauges as fine as 0.020".

SEND NOW for generous FREE SAMPLE and CATALOG E-3.

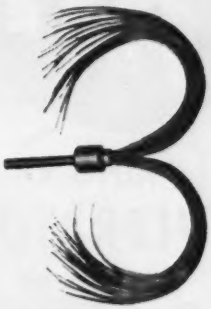
ANCHOR METAL COMPANY
87 Walker St. N.Y. 13 N.Y.
Phone WAlker 5-2512

Matchless precision in miniature slip ring assemblies and commutators

for synchros, gyros, computors, resolvers, instruments and selsyns



32 circuits in one inch



Airflyte
ELECTRONICS COMPANY
21 COTTAGE ST., BAYONNE, N. J.

WRITE

Field Test Positions in CALIFORNIA on Guided Missiles

ENGINEERS

Electronic
Aeronautical
Servomechanical
Telemetering
Mechanical

TECHNICIANS

Electronic
Mechanical

APPLY NOW **for this long-term testing program to:**

FIELD TEST DIRECTOR
BELL AIRCRAFT CORPORATION
NAVAL AIR MISSILE TEST CENTER
POINT MUGU
PORT HUENEME, CALIFORNIA

BELL Aircraft CORPORATION

COMPARISON PROVES...

NEW
UNICON
Super-Compact
TYPE D FILM CAPACITORS
HAVE THESE ADVANTAGES
● SIZE ● WEIGHT ● 125°C PERFORMANCE
THESE CHARACTERISTICS TELL THEIR OWN STORY

CHARACTERISTICS			
Capacitance	0.5 MFD	Case Size	¾" x 1" x 1¾" bathtub
Voltage, DCW	400 up to 125°C	Insulation Resistance	6,000 megs @ 125°C
Weight	1½ oz.		

Write for Data — Catalogs and quotation on request!

UNITED CONDENSER CORP.
337 E. 139th St., N. Y. 54, N. Y.

SPECIFICATION
AN-P-89
PANELS - DIALS - ETC.
BODNAR INDUSTRIES, INC.
19 RAILROAD AVE., NEW ROCHELLE, N.Y.

SEE US AT BOOTH 506—RADIO ENGINEERING SHOW

ATR
AUTO RADIO
VIBRATORS
have Ceramic Stack Spacers
Free
A COMPLETE LINE OF VIBRATORS . . .
Designed for Use in Standard Vibrator-Operated Auto Radio Receivers. Built with Precision Construction, featuring Ceramic Stack Spacers for Longer Lasting Life. Backed by more than 20 years of experience in Vibrator Design, Development, and Manufacturing.
ATR
NEW MODELS
NEW DESIGNS
NEW LITERATURE
"A" Battery Eliminators, DC-AC Inverters, Auto Radio Vibrators
See your jobber or write factory
AMERICAN TELEVISION & RADIO CO.
Quality Products Since 1931
SAINT PAUL 1, MINNESOTA—U. S. A.

BACKTALK

How High The Fidelity

DEAR SIRS:

THE ARTICLE by Cooke and Fletcher entitled, "Cathode-Follower Loudspeaker Coupling" (ELECTRONICS, Nov. 1951, p 118) represents another attempt to make music sound more realistic than it actually is. ELECTRONICS has done a great service by publishing this lampoon of the fetishes which are current among groups of audio enthusiasts.

Such superstitions as requirements for audio bandwidth in excess of human hearing, zero electrical phase shift in spite of huge acoustical phase shifts, elimination of the output transformer at any cost, thoughtless applications of rules of thumb, and the cathode-follower myth are carried to absurdity.

The following deathless quotations illustrate our point:

(1) Page 121, third column, last paragraph: ". . . better results at the high frequencies are obtained, especially in the reproduction of percussion instruments. Here step wave fronts require a frequency response possibly as high as 100 or even 200 kc."

We want to know what improvements in humans the authors recommend so that such frequencies may be heard.

(2) Page 119, first column, third paragraph: "A balance should be maintained in extending frequency response at both ends of the audio (?) spectrum; that is, if an extension of upper frequency response is made to 200,000 cps, then an extension of the lower response frequency should be made to 2 cps. One rule of thumb has been to make the product of the upper and lower half-power frequencies equal to 400,000."

(3) Page 119, third column, first paragraph: "This requirement (on the power supply) was easily accomplished by using four rectifiers, type 872/872A. . . ."

(4) Page 120, first column, second paragraph: "It might be pointed out that there is no hum pickup problem here such as that

WESGO
CRACK-PROOF
CERAMIC SHAPES
FOR
Furnace Brazing
Withstand any amount of thermal shock without cracking. Proven superior to carbon or metal brazing fixtures in positioning vacuum tube components for furnace brazing.
BOAT AT 2000° F. PLUNGED INTO ICE WATER DOES NOT CRACK
● Non reactive with any metals
● Retains shape at high temperatures
● Clean . . .will not rub off on hands and work pieces
● Permanent . . . do not react with air or reducing gases
Available in stock forms of boats or slabs. Special shapes made to your individual specifications.
WRITE FOR DETAILS
WESTERN GOLD & PLATINUM WORKS
589 Bryant Street • San Francisco, Calif.

Exclusives in the coming (Mid-June) electronics

BUYERS' GUIDE

include:

- a cumulative editorial index to ELECTRONICS, 1940-1949 inclusive
- extensive trade name listings
- geographical listings of distributors
- simple telephone book type product listings

ENGRAVE

PANELS OF ANY DIMENSIONS IN YOUR OWN SHOP with the Engravograph

Portable Model I-S

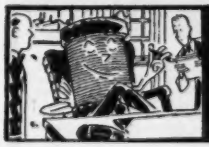
Send for Booklets
I-S 29—portable model
H-29—heavy duty model

NEW HERMES, Inc. 13-19 University Place, N.Y. 3
CANADA: 359 St. James St., Montreal

new hermes
Engravograph

- The only portable machine which reproduces 15 sizes from one master alphabet.
- The only one with adjustable copy holding slides for multiline engraving in one set-up.
- Self-centering holding vise for nameplates.

NEW HERMES, Inc. 13-19 University Place, N.Y. 3
In Canada: 359 St. James St., Montreal
World's Largest Manufacturer of Portable Engraving Machines



Every DANO coil a V.I.C.*
*Very important coil

- Form Wound
- Paper Section
- Acetate Bobbin
- Bakelite Bobbin
- Cotton Interweave
- Coils for High Temperature Applications

ALSO, TRANSFORMERS MADE TO ORDER

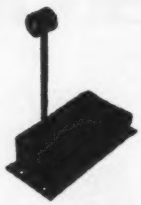
Every Dano Coil gets special treatment, careful inspection and testing in all vital stages of production because every Dano Coil is a *Very Important Coil*—to you for performance, to us for reputation.

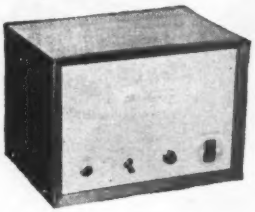
DANO
THE DANO ELECTRIC CO.
MAIN ST., WINSTED, CONN.

SERVOTHERM PRODUCTS

BOLOMETER AND PREAMPLIFIER

Thermistor bolometers are FAST, sensitive INFRARED and HEAT detectors. Especially RUGGED for industrial, scientific, and military applications. PREAMPLIFIER provides NOISE-FREE initial amplification and mount.





THERMISTOR POWER SUPPLY

Provides voltages required by BOLOMETER bridge and PREAMPLIFIER. Regulated and filtered permitting THEORETICAL NOISE LIMITS of amplification, while operating from 60 CYCLE line.

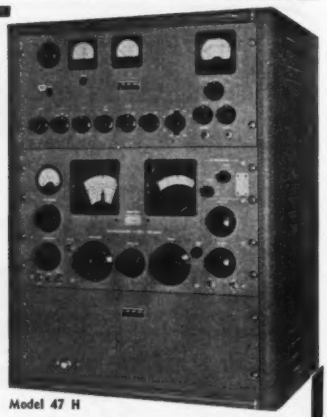
SERVO CORPORATION OF AMERICA

DEPT. E-3 NEW HYDE PARK, N.Y.

Now Available • • • A New Single-Sideband Receiver

The ultimate in performance for long-range radio reception. Receives all forms of double and single-sideband transmission including reduced-carrier single-sideband operation and exalted-carrier double-sideband amplitude-phase-modulation reception.

For program, voice, tone-multiplex and twin-channel operation; optimum performance in rejecting interference; protected against jamming; precision performance with sideband rejection of 60 db; all undesired responses better than 60 db down.



Model 47 H

Complete single sideband receiver, model 47-H, includes single sideband adapter with power supply and standard communication receiver. Provides peak performance for today's techniques—a necessity in meeting tomorrow's advanced requirements in single sideband communications.

ALSO AVAILABLE IN DIVERSITY COMBINATIONS. BULLETIN NO. 518.

CROSBY LABORATORIES, INC.
126 Herricks Road — Mineola, New York

encountered with output transformers owing to winding linkage or magnetic coupling."

(5) Page 121, third column, second paragraph: "The reaction after several months of listening to this system may be likened to living with a great painting."

Great paintings are often spoken of as having great power. This amplifier beats all by several hundred watts. The authors should have pointed out that this amplifier eliminates the need for a heating plant.

WILLIAM L. HATTON
ROBERT A. RAPUANO
Newton, Massachusetts

Authors' Rebuttal

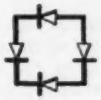
DEAR SIRS:

ELECTRONICS readers, Mr. Hatton and Mr. Rapuano (see above letter) must be acquainted with the analog of the motor car. Many manufacturers design cars capable of speeds approaching 90 miles an hour. These manufacturers do this in order to improve the operation and performance of these cars at more conservative speeds. An amplifier response of 2 cps to 200,000 cps at the half-power points permits excellent phase and amplitude characteristics from 20 to 20,000 cps.

The cathode-coupling unit will hold the 18-inch woofer cone at a half-inch displacement with a suitable d-c signal. In spite of such low-frequency coupling and the 2-cps cutoff of the earlier stages of the amplifier, no hum is audible at full gain setting, even if you place your head inside the cone.

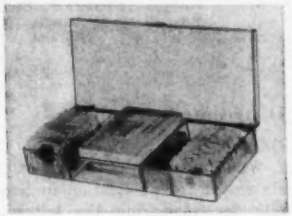
We hasten to explain to readers Hutton and Rapuano that the authors are not proposing such a direct coupler as a commercial amplifier, but simply as a power transfer unit which has the ability of reproducing in a pure 16-ohm resistor a voltage exactly like the voltage output of a microphone placed judiciously in Symphony Hall. If this contributes to the house heating to the tune of about a penny an hour, there are several scores of ELECTRONICS readers who have, are, and will accept such by-products graciously in return for superior low-frequency results, as

CAN YOUR DRAFTSMAN DRAW THIS SYMBOL IN 3 SECONDS?



If he can't he is turning out only half as much work as he should.

Laborious hand drawing of symbols is an antiquated practice that should have been abandoned years ago. Now, with TRANSPARENT printing stamps you can reduce your drafting labor costs by 50%. Alignment is no problem: you can see through the complete stamp.



All of the 24 symbol stamps in each kit will make perfect prints of electronic symbols. Opaque ink for tracings is included.

In addition ALL of your drawings can be STANDARD.

Write for details and sample prints.

JOHN GRIFFIN COMPANY

2157 James Ave. St. Paul 5, Minn.

FOR YOUR PANEL

DIALCO

A NOVEL and UNIQUE CIRCUIT INDICATOR

DESIGNED FOR NE-51 NEON LAMP

For 110 or 220 volt circuits

The required resistor is an integral part of this assembly —"built-in."

RUGGED • DEPENDABLE LOW IN COST

PATENTED: No. 2,421,321
Cat. No. 521308-997

WILL *YOU* TRY A SAMPLE?

Write on your company letterhead. We will act at once. No charge, of course.

SEND FOR THE 192 PAGE HANDBOOK OF PILOT LIGHTS

Among our *thousands of Pilot Light Assemblies* there is one which will fit *your special conditions.* Many are especially made and approved for *military* use. We pride ourselves on prompt deliveries—*any quantity.*

ASK FOR OUR APPLICATION ENGINEERING SERVICE

Foremost Manufacturer of Pilot Lights

The DIAL LIGHT COMPANY of AMERICA

900 BROADWAY, NEW YORK 3, N. Y. SPRING 7-1300

MICO

Precision Apparatus

UHF COAXIAL WAVEMETERS

2 - 75 CENTIMETER RANGE

MODEL 433...20 to 75 Centimeters
MODEL 501... 4 to 20 Centimeters
MODEL 402A.. 2 to 10 Centimeters
MODEL 402B.. 2 to 10 Centimeters
(Reaction Type)

MICO INSTRUMENT CO.

76E TROWBRIDGE ST., CAMBRIDGE, MASS.

PIX

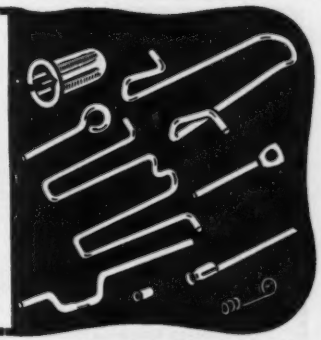
WIRE FORMING SPECIALISTS

Precision Parts to meet your Production and Engineering needs. From .002" dia. to .125" dia. Radio tube parts—Stampings—Drawings Modern facilities, high-production equipment.

Metal Crystal Holder Parts

Send sketch or print for quotation.

PIX MANUFACTURING CO., Inc.
24 Bedford St., Newark 3, N. J.



SCOPE DOLLY

Model 1

Convenient Height and Viewing Angle
Adjustable to Hold Portable Scopes
Ball Bearing Swivel Rubber Tired Casters
Lightweight Aluminum Construction
Recommended by Laboratories Wherever Used

$35.00 FOB LOUISVILLE, KY.

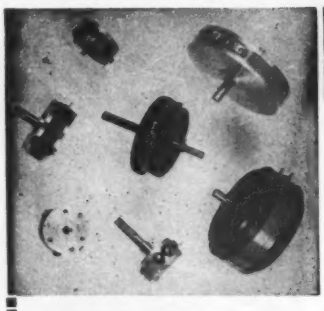
Formerly manufactured by UNIQUE DEVICES

Now manufactured and sold by

TECHNICAL SERVICE CORPORATION

3116 Michigan Drive Louisville 5, Kentucky

versatile
Multi-channel telegraph A1 or telephone A3.
FROM GROUND TO AIR OR POINT TO POINT
STABLE
High stability (.003%) under normal operating conditions.
RUGGED
Components conservatively rated. Completely tropicalized.
Model 446 transmitter operates on 4 crystal-controlled frequencies (plus 2 closely spaced frequencies) in the band 2.5-13.5 Mcs (1.6-2.5 Mcs available). Operates on one frequency at a time; channeling time 2 seconds. Carrier power 350 watts. A1 or A3 AM. Stability .003% using CR-7 (or HC-6U) crystals. Operates in ambient 0° to +45° C using mercury rectifiers; -35° to +45° C using gas filled rectifiers. Power supply, 200-250 volts, 50/60 cycles, single phase. Conservatively rated, sturdily constructed. Complete technical data on request.
Here's the ideal general-purpose high-frequency transmitter! Model 446... 4-channel, 6-frequency, medium power, high stability. Suitable for point-to-point or ground-to-air communication. Can be remotely located from operating position. Co-axial fitting to accept frequency shift signals.
Consultants, designers and manufacturers of standard or special electronic, meteorological and communications equipment.
AER -O- COM
AERONAUTICAL COMMUNICATIONS EQUIPMENT, INC.
3090 Douglas Road Miami 33 Florida



PRECISION POTENTIOMETERS

Type RL-270: Wedding ring type . . . five sizes charted below. Gamewell Potentiometers are precision instruments in every respect. They feature close limits in electrical characteristics and mechanical construction, low electrical noise, low torque, and long life. All types operate at −55°C. to +55°C., 95% relative humidity at altitudes up to 50,000 ft. Non-linear windings are available.

CONDENSED SPECIFICATIONS	RL-272	RL-270	RL-271	RL-275	RL-277
Diameter (in.)	5	3	2	1⅝	1¼
Rating (watts)	12	6	3	2	1.5
Torque, max. (oz. in.)	1	1	1	½	½
Weight (oz.)	15	6	3	2	1
Mounting: 3 holes ⅛" deep	#8-32	#8-32	#8-32	#6-32	#4-40
Mounting circle diam. (in.)	3.250	1.750	1.250	1.000	1.000
Max. resistance (ohms) ± 10%	500,000	275,000	160,000	105,000	64,000
Min. resistance (ohms) ± 10%	460	250	150	105	80
Max. useful angle (deg.)	358±½	356±½	354±½	352±½	350±½
Max. resolution (%)	0.05	0.08	0.15	0.2	0.25
Min. resolution (%)	0.01	0.015	0.025	0.04	0.05
Linearity (%)	±0.10	±0.10	±0.15	±0.25	±0.30

Standard Shaft: single end, ¾" extension, specify if otherwise.
Double ended shaft special; specify diameter and length.
Multiple sections can be ganged, add ⅝" to the overall length for each additional section.
Terminals will be positioned on the circumference as required for taps and winding angle.
Expected life of all types over 1,000,000 cycles.

FOR COMPLETE DETAILS SEND FOR BULLETIN F-68-A

THE GAMEWELL COMPANY
NEWTON UPPER FALLS 64, MASSACHUSETTS

well as high-frequency response as good as the best amplifiers available.

Now the game is to find much better speakers, so that the authors may avocationally brew a pot of witchcraft and superstitions that will correlate laboratory measurements with listening judgments.

EWAN W. FLETCHER
Cruft Laboratory
Harvard University
Cambridge, Massachusetts
AND
STUART P. COOKE
Case Institute of Technology
Cleveland, Ohio

Distributed Amplifiers

DEAR SIRS:

I WISH to submit the following statement for publication in *Backtalk* for answering the letter of July 12, 1951, from G. G. Kelley, Physics Division, Oakridge National Laboratory.

Figure 1 shows the plate characteristic of a pentode in a stage of distributed amplifier. For example,

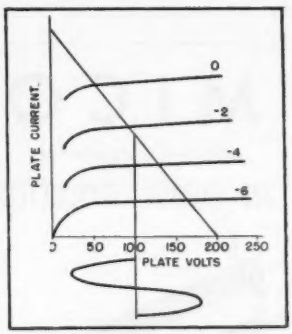


FIG. 1—Plate characteristic of a pentode in a stage of distributed amplifier

the grid reaches zero potential (or slightly negative) and the potential of its plate reaches about 20 volts when a sine wave of about 3 volts peak is applied to the grid line. If the receiving end of the plate line is opened T μsec later, this wave will reflect back to the plate of this particular tube. If the frequency of the applied signal is such that the next positive peak of the grid signal occurs at the same instant when the potential of the plate is reduced to 20 volts by the reflected wave, $f = 1/T$, the maxi-

COMING

to all

subscribers

IN JUNE

the 12th

Annual

electronics

BUYERS'

GUIDE

the first

completely

verified

directory

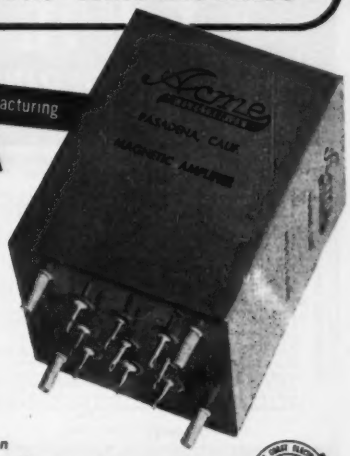
ACME MAGNETIC AMPLIFIERS

Design Experience

Precision Manufacturing

Prompt Delivery

Custom Built to Your Need



Acme's extensive know-how in the development of Magnetic Amplifiers can provide you with the precise component to fit your exact requirement.

These characteristics can be supplied—

- *Power gains as high as 10 million*
- *Carrier operating frequencies from 60 cps to 100 kcs*
- *Power output up to 20 watts*
- *Input sensitivity to 0.10 microwatts*

Write today for catalog page and specification form in which you can list your requirements.

Acme ELECTRONICS INC

300 No. Lake Ave., Pasadena 4, Calif

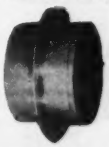
Wave Filters • Delay Lines • Magnetic Amplifiers • Special Transformers & Chokes • Toroidal, Universal & Solenoid Wound Inductors

TUNGSTEN LEADS
BASES AND CAPS
SPOT WELDERS
COMPLETE ASSEMBLIES

- THE ENGINEERING CO. NOW IN PRODUCTION HYDROGEN THYRATRON TUBE BASE.
- PRECISION MANUFACTURE OF METAL PARTS

Manufacturing Component Parts for Electronic Tubes Since 1923.

Tungsten Leads are important factors of the tube. High quality leads make quality tubes. Engineering Co. makes the finest leads. No leakage or breakage when you buy our leads. Parts made to customers specification.



Quality tubes depend on quality bases and caps. We make all types including also an all glazed ceramic base.

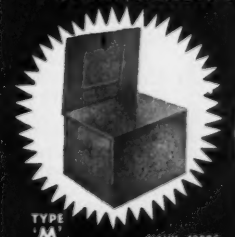
Our engineers will be happy to help you with any of your problems.

Send Us Your Prints for Quotations.

THE ENGINEERING CO.

Daniel Kondakjian. 27 WRIGHT STREET • NEWARK 5, N. J.

SPECIFICATION NAVY SPARE PARTS BOXES



JAN-B-233

NOW available to you . . . . .
without costly sub-contracting problems

STOCK SIZES . . . . AT PUBLISHED PRICES

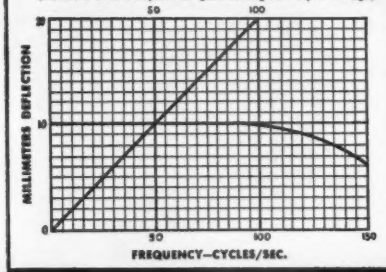
You can DEPEND ON DOLIN just as do many of the major Navy Prime Contractors (non-magnetic boxes, too!). Simply order them by stock number.

WRITE FOR SIZE AND PRICE CHART

DOLIN METAL PRODUCTS, INC.
121 LEXINGTON AVE. BROOKLYN 16, N. Y.

RAHM
DIRECT RECORDING
INSTRUMENTATION

% INPUT VOLTS FOR FULL SCALE DEFLECTION
(Absolute values depend on gain setting and input voltage)



Write for Bulletin R 1052

RAHM INSTRUMENTS, INC.
12 WEST BROADWAY • NEW YORK 7, N. Y.

OSCILLOGRAPHS AND AMPLIFIERS
unsurpassed for

- Amplitude Linearity
- Wide Band Frequency Response
- Rugged and Practical Construction for Field and Mobile Operation
- Heat Sensitive Recording Medium of wide dynamic range

See Us
at Booth No. 271
Radio Engineering Show

RECORDER AND AMPLIFIER COMBINATIONS

- 1, 2, 4, or 6 channel recorders driven by a selection of DC, high gain AC or combination AC/DC amplifiers
- Rack mounted, mobile units are available

ELECTRONICALLY REGULATED
LABORATORY
POWER SUPPLIES

AS EXHIBITED AT THE-

FORTY YEARS 1912 1952
SETS THE PACE
IRE SHOW

Radio Engineering Show · March 3-6,
Grand Central Palace New York City 1952

BOOTH
#345

VISIT OUR DISPLAY
OF CURRENT AND
NEW MODELS

LAMBDA ELECTRONICS
CORPORATION
CORONA NEW YORK

ELECTRONICALLY REGULATED
LABORATORY
POWER SUPPLIES

BENCH MODEL 50

DEPENDABLE
MODERATELY PRICED
ALSO AVAILABLE STANDARD RACK MOUNTING
MODEL 50-R PANEL SIZE 19" x 19" DEPTH 14½"

- INPUT: 105-125 VAC, 50-60c
- OUTPUT #1: 0-500 VDC at 500 ma regulated
- OUTPUT #2: 0-50 VDC, 0-200 VDC Bias Output.
- OUTPUT #3: 6.3 VAC at 5A unregulated
- OUTPUT #4: 6.3 VAC at 5A unregulated
- RIPPLE OUTPUT: Less than 8 millivolts rms

For complete information write for Bulletin R

LAMBDA ELECTRONICS
CORPORATION
CORONA NEW YORK

mum variation in plate potential of the tube, due to this positive peak signal, is therefore less than 20 volts instead of 80 volts for the preceding positive peak. Thus, the gain is very different when the plate of a tube sees a half-wavelength opened line. However, at very low frequency, the electrical length of the plate line is very small compared with the wavelength of the applied signal, and this condition may not occur at all. Thus, the gain is different for different frequencies.

Figure 2 shows the plate characteristic of the same tube when a positive pulse is applied to the grid line. For example, at the instant when the plate potential is reduced to 20 volts by the reflected wave from the opened receiving end, the next applied pulse just reaches the grid of the same tube. Then the maximum variation in plate current of this particular tube is much less than that due to the preceding applied pulse, because the operating load line has been temporarily pushed to the knees of the characteristics. Thus, the amplification of the amplifier depends upon both the repetition frequency and the duration of the applied pulse.

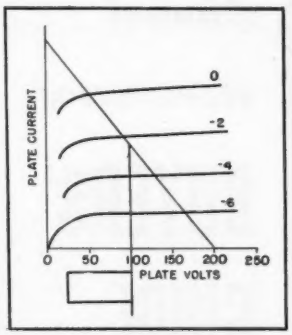


FIG. 2—Plate characteristic of same tube as shown in Fig. 1 with positive pulse applied to grid line

The conditions for constant amplification with the receiving end opened are: (1) the tube characteristics are perfectly linear, and (2) the quiescent plate potential is more than twice of the peak value of the output signal.

Unfortunately, the first condition is very difficult to be found with

THIS FEATHERWEIGHT WILL

LICK SOLDERING FATIGUE!

THE NEW

HEXACON BANTAM

MODEL 30H

Weight—5½ Ounces • Watts—40 or 60 • Tip Dia.—Both ⅛" and ¼" Tips Furnished with Each Iron • Price— $5.00

So light its weight is hardly noticeable. Outperforms any iron of equal size. Hatchet design makes it more comfortable and practical to use than a pencil iron. No transformer required. Write for complete catalog.

HEXACON

HEXACON ELECTRIC CO.
130 WEST CLAY AVE., ROSELLE PARK, N. J.

ZOPHAR

WAXES

COMPOUNDS

Zophar Waxes, resins and compounds to impregnate, dip, seal, embed, or pot electronic and electrical equipment or components of all types; radio, television, etc.

Cold flows from 100°F. to 285°F.

Special waxes non-cracking at −76°F.

Compounds meeting Government specifications plain or fungus resistant.

Let us help you with your engineering problems.

ZOPHAR MILLS 106 YEARS QUALITY SERVICE EXPERIENCE

ZOPHAR MILLS, INC.
112-130 26th Street,
Brooklyn 32, N. Y.

for the ELECTRONIC INDUSTRIES

Quality Ribbons STRIPS

MOLYBDENUM
TUNGSTEN
TANTALUM
FORMED PIECES

•

Your Special Metals Rolled to Thin Sizes & Close Tolerances

•

YOUR INQUIRIES WILL RECEIVE PROMPT ATTENTION

H. CROSS CO.
15 BEEKMAN ST., N. Y. 38, N. Y.
WOrth 2-2044 and COrtlandt 7-0470

Little thought-of facts about capacitors

The short time breakdown voltage of a well-made D.C. capacitor is not less than 5 to 6 times the actual working voltage at 20°—

$E = 5 \times e$ min

E = Breakdown voltage
e = Rated d.c. working voltage

INDUSTRIAL CAPACITORS are unvaryingly held to this formula.

Designed for maximum safety and the smallest possible volume, INDUSTRIAL CAPACITORS are the most widely used capacitor in industrial applications.

WRITE TODAY FOR DETAILED CATALOG

Watch this space for other capacitor facts that will help you.

INDUSTRIAL CONDENSER CORP.

Sales Offices in All Principal Cities
3243 N. California Ave.
Chicago 18, Illinois

WASHERS—ALL KINDS

WASHER SPECIALISTS for nearly half-a-century. Dies in stock will produce most sizes. Big runs made with automatic presses. An economical, accurate, and highly reliable source for washers, also all kinds of metal stampings. HAVE WHITEHEAD'S CATALOG ON FILE; write for it.

BEVELED
CUP
D-HOLE
RETAINER
LOCK
SPACERS
SPRING TENSION
SQUARE HOLE
STAR LOCK
THRUST
TONGUE

EST. 1903 WHITEHEAD STAMPING COMPANY

1691 W. LAFAYETTE • DETROIT 16, MICH.

SMALL PARTS PLAY A **BIG** PART IN PRECISION INSTRUMENTS

HERE, for example, are typical sliding contacts now being supplied by us to manufacturers of precision potentiometers. PALINEY* #7, Ney-developed precious metal alloy from which they are made, has just about ideal physical and electrical properties for this service. It has very high tarnish resistance and is unaffected by most industrial atmospheres. Its hardness, controlled by simple heat-treatment, is especially suited to use with the nickel-chrome type of resistance wire, as well as our own high strength NEY-ORO G precious metal resistance wire. Potentiometers so equipped, have demonstrated service life of up to 20 million cycles with excellent sustained linearity and low noise level.

This is just one of many new and important precious metal alloy developments of interest to instrument and electronic engineers detailed in our new Technical Bulletin #R-12. Write for your copy.

*Reg. T. M. J. M. Ney Co.

THE J. M. NEY COMPANY, 179 Elm Street, Hartford 1, Connecticut
Specialists in Precious Metal Metallurgy Since 1812.

we're on the move to..

• **INCREASED FACILITIES !**

• **IMPROVED DELIVERIES !**

Our **NEW** plant is ready to meet the increasing demand for COIL-WINDING EQUIPMENT that has RUGGED CONSTRUCTION-VERSATILITY of ACTION-EASE of SET-UP

Compare... and you will find one of our many models to be the best for your requirements

LOOK US UP AT BOOTHS 353-355 I R E SHOW GRAND CENTRAL PALACE

Write for detailed listings and descriptions

Coil Winding Equipment Co.
109 AUDREY AVE., OYSTER BAY, NEW YORK

practical tubes and the second condition is very undesirable to establish in the output stage of a distributed amplifier. Precisely, open line can only be used in the output stage of a distributed amplifier, and usually the condition for maximum plate current swing, without exceeding the maximum allowable plate dissipation of a given tube, is the most important factor in the output stage.

Y. P. YU
Development Engineering Section
Instrument Division
Allen B. Du Mont Laboratories, Inc.
Clifton, New Jersey

Horn TV Antennas

DEAR SIRS:

SINCE you published my article entitled, "Horn Antennas for Television" (ELECTRONICS, Oct. 1951, p 84) I have received many queries and comments both personally and by mail. Some of the reports have been excellent and others very poor. The antenna as it stands is unfortunately quite difficult to keep up in the air during any kind of wind.

One slight error should be brought to the attention of your readers, however. It does not effect the final results, but as it stands the math is incorrect. The equation for dimension B_o should read

$$B_o = \frac{W_o}{2 \sin \phi/2} = \frac{0.5 \text{ cutoff}}{2 \sin 30°} = 0.5\lambda_o$$

In this article the 2 under the angle ϕ was omitted.

DEAN O. MORGAN
General Electric Company
Electronics Park
Syracuse, New York

Duality

DEAR SIRS:

AFTER PERUSAL of the article by Gordon Raisbeck entitled, "Transistor Circuit Design" in the December 1951 issue of ELECTRONICS (p 128), as well as the reference paper, "Duality as a Guide to Transistor Circuit Design", I would like to submit the following simple extension of the usual graphical method for the derivation of dual circuits, in support of Mr. Raisbeck's paper.

The method is outlined for stand-

PROFESSIONAL SERVICES

Consulting—Patents—Design—Development—Measurement

in

Radio, Audio, Industrial Electronic Appliances

CROSBY LABORATORIES, INC.

Murray G. Crosby & Staff

Radio - Electronic Engineering

Research & Development
FM, Communications, TV
Test Equipment

Offices, Laboratory & Model Shop at:
126 Herricks Rd., Mineola, N. Y.
Garden City 7-8812

READERS MAY CONTACT THE CONSULTANTS

with the confidence justified by the offering of these special services nationally.

Whose Cards Appear on This Page

ALBERT PREISMAN

Consulting Engineer

Television, Pulse Techniques, Video Amplifiers, Phasing Networks, Industrial Appliances
Affiliated with
MANAGEMENT-TRAINING ASSOCIATES
2308-14th St., N.W. Washington 10, D. C.

DUBROW DEVELOPMENT CO.

Design — Development — Mfr.

Quality Electronic Equipment

347 High St. Burlington, N. J.
Burlington 2-0446

R. W. HODGSON

PATENT AGENT SPECIALIZING IN ELECTRONICS

Registered to Practice Before the U. S. & Foreign Patent Offices

Office—6080 Lexington Ave., Hollywood 38, Calif.
All Mail to Box 874, Sherman Oaks, Calif.
GLadstone 9630

RESDEL ENGINEERING

MISSILE GUIDANCE, electronic research, development, and manufacturing.

INFRARED RECEIVERS
MAGNETIC AMPLIFIERS

2309 Riverside Dr., Los Angeles 39, Calif.
NOrmandy 6809

EDGERTON, GERMESHAUSEN & GRIER, INC.

Consulting Engineers

Research, Development and Manufacture of Electronic and Stroboscopic Equipment
Specialists in High-Speed Photography

160 Brookline Avenue, Boston 15, Mass.

HOGAN LABORATORIES, INC.

John V. L. Hogan, Pres.

Applied Research, Development, Engineering

Est. 1929. Exceptionally competent staff. Electronics, Optics, Mechanisms, Facsimile Communication, Electro-sensitive recording media, Instrumentation.

155 Perry Street, New York 14 CHelsea 2-7855

SKINNER, HARLAN AND IRELAND, INC.

Consulting Engineers

Specializing in Magnetic Materials and Their Application

Office and Laboratory Indianapolis 7, Indiana

Eldico of New York Inc.

Pioneers of Television Interference Elimination from Transmitters, Induction Heaters, Diathermy and etc.

Donald J. S. Morton & Engineering Staff
44-31 Douglaston Pkwy Douglaston, N. Y.
Bayside 9-8686

MEASUREMENTS CORPORATION

Research & Manufacturing Engineers

Harry W. Houck Jerry B. Minter
John M. van Beuren
Specialists in the Design and Development of Electronic Test Instruments

Boonton, N. J.

THE TECHNICAL MATERIEL CORPORATION

Communications Consultants

Systems Engineering
General Offices and Laboratory

121 Spencer Place, Mamaroneck, N. Y.

ERCO RADIO LABORATORIES, INC.

Radio Communications Equipment

Engineering - Design - Development - Production
Pioneers in Frequency Shift Telegraph

Garden City • Long Island • New York

Eugene Mittelmann, E.E., Ph.D.

Consulting Engineer & Physicist

High Frequency Heating—Industrial Electronics
Applied Physics and Mathematics

549 W. Washington Blvd. Chicago 6, Ill.
State 2-8021

TELECHROME, INC.

Electronic Design Specialists

COLOR TELEVISION EQUIPMENT
Flying Spot Scanners, Color Synthesizers, Keyers, Monitors, Oscilloscopes and Related Apparatus

J. B. Popkin-Clurman, *Pres. & Ch. Engr.*

83 Merrick Rd. Amityville, L. I., N. Y.

HERMAN LEWIS GORDON

Registered Patent Attorney

Patent Investigations and Opinions

Warner Building, Washington 4, D. C.
NAtional 2497

NIAGARA ELECTRON LABORATORIES

CONSULTATION - DESIGN - CONSTRUCTION
MFG. THE THERMOCAP RELAY

Specializing in solution of problems of electronic and electro-physical instrumentation for the research or analytical laboratory. Industrial plant problems also invited.

Andover, New York Cable Address: NIATRONLAB

FREDERICK P. WARRICK

Engineering Consultant

Development & Manufacture of High Speed Moving Film Cameras for Oscillography & Stroboscopic Photography

1900 Grasfield Road Birmingham, Michigan

HANSON-GORRILL-BRIAN INC.

Products & Mfg. Development

ELECTRICAL - ELECTRONIC
HYDRAULIC - MECHANICAL

One Continental Hill Glen Cove, N. Y.
Glen Cove 4-1922

PHYSICAL RESEARCH ASSOCIATES

Manufacturers of Physical Research Equipment
Management Consultants & Industrial Engineers
Arthur M. Vigilante, Director

High-gain Television Receiving Arrays, Regulated Power Supplies, Low Light Level Detection & Recording Systems for Raman Spectroscopy. Narrow Band-width Amplifiers. Dynamic Condenser Electrometers.

#1 Acurelee Drive Malibu, Calif.

WHEELER LABORATORIES, INC.

Radio and Electronics

Consulting—Research—Development
R-F Circuits—Lines—Antennas

Microwave Components—Test Equipment
Harold A. Wheeler and Engineering Staff

Great Neck, N. Y. Great Neck 2-7806

R. W. HODGSON

RESEARCH & DEVELOPMENT ENGINEER SPECIALIZING IN ELECTRONICS, NUCLEONICS, INSTRUMENTATION, SERVOMECHANISMS & CYBERNETICS

Office—6080 Lexington Ave., Hollywood 38, Calif.
All Mail to Box 874, Sherman Oaks, Calif.
GLadstone 9630

PICKARD AND BURNS, INC.

Consulting Electronic Engineers

Analysis and Evaluation of Radio Systems

Research, Development and Design of Special Electronic Equipment

240 Highland Ave., Needham 94, Mass.

YARDNEY LABORATORIES, INC.

Research - Design - Development

Electro-Chemical Generators of Energy

105 Chambers Street WOrth-2-3334, 35, 36
New York 7, N. Y.

ULANET
Miniature
THERMOSTATS
... the smallest in the world!
During the past 20 years more types of Thermal Controls have been built by Ulanet than by any other manufacturer ... proof of Ulanet versatile-leadership in Thermal Control Engineering. If you have a control problem write stating the application.
GEORGE ULANET COMPANY
417 MARKET STREET
NEWARK 5, NEW JERSEY
Pioneer Thermostat Manufacturer
SINCE 1931

SINCE 1931
ULANET
ELECTRIC HEAT CONTROL ENGINEERS

THE ULANET ORGANIZATION SPECIALIZES IN THE DESIGN AND MANUFACTURE OF

THERMAL UNITS

FOR ALL TYPES OF

TIMING & THERMOSTATIC CONTROLS

It will pay you to compare our units — contact us and you'll save time & money by using engineered Ulanet Controls.

★ ★ ★ ★ ★ ★

Here's Why it Pays You ... to Read the Advertising

The advertising is a rich source of valuable information. In this magazine it offers you ideas and products that may well apply advantageously to your business.

Every issue is a catalog of goods, materials, and services — quickly available to you — just for the reading.

Leaders in business and industry turn to the advertising because they've discovered it helps them run their businesses more profitably.

When you read all the ads in this magazine, the chances are good that you'll get a lead that will materially help you do a better job. For example, you may find a specific piece of equipment that will be a profitable time-saver Or a tool that will increase worker efficiency That's why it pays to read the advertising. It's good business.

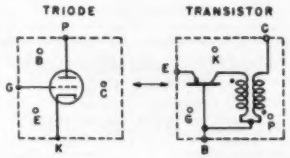
HEADQUARTERS FOR BUSINESS INFORMATION

McGRAW-HILL publications

F-23

ard circuit elements in the book, "Transients in Linear Systems" by Gardner and Barnes beginning on page 46.

Vacuum tubes such as triodes (or tetrodes and pentodes with their screen grids held at fixed potentials) can be represented by their equivalent circuit using, for example, two independent remote-controlled voltage generators with series resistance and can thus be dealt with by the method. On inspection it will appear that the dual of the triode is the transistor and vice versa as pointed out by Raisbeck. To deal with these circuit elements graphically only the following very simple rules are required:



Proceeding from triode to transistor, the point C in the loop containing cathode and plate becomes the collector node; the point E in the loop containing cathode and grid becomes the emitter node; and the point B in the loop containing plate and grid becomes the base node.

Proceeding from transistor to triode, the point P in the loop containing base and collector becomes the plate node; point G in the loop containing base and emitter becomes the grid node; and point K in the loop containing collector and emitter becomes the cathode node.

In addition there is a 180-degree phase reversal either in the emitter or collector circuit (as shown) when proceeding from triode to transistor. When proceeding from a plain transistor (that is, one not containing a phase reversing transformer) to a triode, a phase reversing transformer should be included in the grid or plate circuit. This will not present any difficulty and can be omitted from some circuits.

Using this simple graphical method it is possible to construct the dual of any planar circuit con-

CONTACTS
FOR THE FIELD OF ELECTRONICS

MICO "SOLDERUX"
INSTRUMENT SOLDERING FLUXES

Non-Corrosive. Especially recommended for soft soldering fine wires and small parts of many metals including steel, brass, chromel, constantan, nickel, silver and copper. Mico Solderux Liquid for vigorous action—Mico Solderux Cream for strong action—Mico Solderux Paste for milder action. These fluxes are unique in that chemical action, so necessary in cleaning metals of oxides, grease, and dirt, does not begin until soldering temperatures are reached. When the work cools, any remaining flux subsides into a chemically inert material of low conductivity having non-hygroscopic properties. 1 oz. trial jar—50¢.

MICO INSTRUMENT CO.
76E Trowbridge St. Cambridge 38, Mass.

BMC *Manufacturers of*
ELECTRONIC AND ELECTRICAL APPLIANCES • ELECTRONIC PROTOTYPES
BRUBAKER MANUFACTURING COMPANY INC.
9151 Exposition Drive • Los Angeles 34, California • TExas 0-5313

how to understand
- **ELECTRONIC COMPUTERS**
- **CONSTRUCTION of ROBOTS**
- **MANY OTHER SUBJECTS**

Courses or guided study, by mail—Fitted to your own interests and needs—Beginning or advanced —Individuals or study groups—Cost, $22.00 to $35.00 (less for study groups)—Scholarships—We have enrollments in 33 states and 6 foreign countries.

Write Today For Detailed Folders
Edmund C. Berkeley and Associates
Makers of SIMON, the Mechanical Brain, and SQUEE, the Robot Squirrel. (See cover pictures and articles in Radio Electronics, Oct. 1950, and Dec. 1951) Mr. Berkeley is author of *Giant Brains or Machines that Think*. Wiley, 1949.
36 West 11 St., D 21 • N. Y. 11, N. Y.

GRC WING NUTS TOP QUALITY PRICED LOWER
Rust-proof zinc alloy with GRC's recessed-wing finger-grip. All commercial finishes, all popular thread sizes. Special threads or untapped wing nuts; special designs to order.
Write today for samples and prices—and compare!
GRIES REPRODUCER CORP.
100 Willow Ave., N. Y. 54 • Phone: MO 5-7400

New **WIRE CUTTER AND STRIPPER**
Big **TIME SAVER**
Snips wire to 18 gauge ... gets in hard to reach places ... perfect for holding wire or other small parts. Contact your radio parts jobber or Jim Handy representative.
Jim HANDY
EASY ACTION WIRE CUTTER
C & G Mfg. and Sales Co.
Box 1525 Columbus, O.

FOR MAINTENANCE OF MOBILE COMMUNICATIONS SYSTEMS
MICROMETER FREQUENCY METER
FM MODULATION METER
LAMPKIN LABORATORIES, INC.
Bradenton, Florida

EL-TRONICS, INC.
Research—Development—Manufacture
A single unit to large production quantities. Specialists in Nuclear Instruments, Test Equipment and Instrumentation
Send for Free Resume of our Facilities
2857 N. Howard St. - Phila. 33, Pa.
GArfield 8-2026

SUB-CONTRACTING
MILITARY and COMMERCIAL
receivers—test equipment
transmitters—controls
sub-assemblies
TELETRONICS LABORATORY, INC.
Westbury, L. I., N. Y. Westbury 7-1028

ALLEN
FLUXES
SOLDERING
BRAZING & WELDING
L. B. ALLEN CO. INC. Chicago 31, Ill.
6751 BRYN MAWR AVE.

Shorted Turn Indicator
for wound coils
MODEL 101C BULLETIN 42
HUNTINGTON BEACH, CALIF.
KARTRON

We do **Sub-Contracting**
for Military & Commercial
sub-assemblies • test equipment • receivers
MICHEL MANUFACTURING CO.
227 North Water Milwaukee, Wisconsin

DELIVERY FROM STOCK **JAN-C-25 CAPACITORS** YOU NAME IT WE HAVE THEM
CHANNELS—YAB CP69 • YAT CP67 • WAB CP65 • WAT CP63
UPRIGHT TYPES—CP40, 41 • CP81 with universal brackets • CP70 series
BATHTUB TYPES—CP53 plate terminals CP54 lug terminals CP55 bottom terminals
CHANNELS & BATHTUB TYPES AVAILABLE in SINGLES DUAL OR TRIPLE UNITS
CAPACITY VALUES—.01-.02-.05-.1-.25-.5-1.0-2-4-6-8-10-15 MFD
VOLTAGES AVAILABLE—50-100-200-400-600-1000-1500-2000-2500-3000 etc.
CA TYPES AVAILABLE
Most Types in Very Large Quantities • Let Us Quote on Your Requirements
MODULATION PRODUCTS COMPANY 56 Lispenard St. Barclay 7-2684 New York 13, N. Y.

WA E-RECORDALL BATTERY RECORDER PLAYBACK
Continuous, permanent, indexed recording, up to 4 hrs., only 5¢ hr. Instantaneous, permanent playback. Picks up sound up to 60 ft. Records conferences, lectures, dictation, 2-way phone & sales talks; while walking, riding or flying. Records in closed briefcase with "hidden mike"! Write for Detailed Literature.
MILES REPRODUCER CO., INC.
812 BROADWAY Dep't E-3 NEW YORK 3, N. Y.

EISLER Manufactures Complete Equipment for:
SPOT WELDERS, Electric for ¼ to 250 KVA
TELEVISION TUBE GLASS WORKING EQUIPMENT
TRANSFORMERS, Special and Standard Types
INCANDESCENT LAMP Manufacturing Equipment
FLUORESCENT TUBE Manufacturing Equipment
NEON SIGN MAKERS EQUIPMENT
ELECTRON EQUIPMENT, Vacuum Pumps, etc.
WET GLASS SLICING and Cutting machines for Laboratory use
EISLER ENGINEERING CO. INC.

Introducing a complete line of

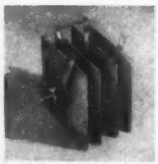
CUSTOM BUILT SELENIUM STACKS

with these outstanding features

Selected rectifier plates . . . All plates individually tested and hand-picked for uniform resistance and voltage characteristics, before assembly.

Result: A stack which runs cooler, which can stand a greater overload, which has no "weak spot" where failure can start. Exclusive corrosion-proofing process . . .

Each stack is given a multiple coat of a special corrosion-resistant enamel, applied by our own dip process, and then sprayed with moisture- and fungus-proof varnish.



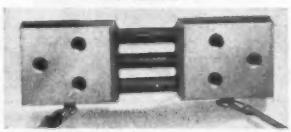
FULL WAVE BRIDGE TYPES

Volts in/Volts out	Current continuous Amperes	Price
22/18	2	$ 3.00
22/18	4	5.50
26/22	15	20.00
26/22	30	39.00
26/22	45	56.00
30/24	5.2	7.50
30/24	10	15.00
30/24	15	25.00
30/24	20	29.00
30/24	30	46.50
30/24	45	67.50
36/28	15	27.00
36/28	30	52.00
36/28	45	73.00
44/36	2	3.50
44/36	4	10.50
44/36	10	18.00
44/36	15	30.00
44/36	20	36.00
44/36	30	56.00
44/36	45	83.00
60/48	5.2	14.50
60/48	10	21.00
135/120	2	14.50
135/120	4	26.50
135/120	10	62.50

We invite your inquiries on complete power supplies for end equipment, bench rectifiers, remote controls, periodic reversing equipment, automatic controls, custom building and accessories.

50 MILLIVOLT SWITCHBOARD SHUNTS FOR D.C. INSTRUMENTS

complete with calibrated 10 ft. leads and hardware



Range in Amps.	Price
100 Amp.	$ 6.00
200 Amp.	6.50
300 Amp.	7.50
500 Amp.	12.00
750 Amp.	17.50
1000 Amp.	23.00
1500 Amp.	30.50
2000 Amp.	37.50
3000 Amp.	51.00

These shunts are dipped in a special corrosion-resistant enamel, and then sprayed with moisture and fungus-proof varnish.

INDUSTRIAL RECTIFIER COMPANY

120 Cedar Street, New York 6, N. Y.
Tel. Digby 9-3832

BACKTALK (continued)

taining vacuum tubes (leading to transistors) or transistors (leading to vacuum tubes), of which many examples are given in the articles mentioned at the beginning of this letter.

HANNS J. WETZSTEIN
Graduate Student
Harvard University
Division of Applied Science
Cambridge, Mass.

Electronics Quiz

IN THIS MONTH'S brain teaser, the reader is asked to account for a seemingly peculiar chain of circumstances that actually happened to Elliott M. Barr of Rochester, New York. The story is as follows:

"During a particularly energetic thunderstorm, a group of students were studying in the dining room of a fraternity house at a midwestern university. A loud crash of thunder and flash of lightning plunged the house into darkness except for the pilot light and tube filaments in the radio in the adjoining living room, which had not been turned on before the crash.

"Playing a hunch, I suggested that as long as we could not study in darkness, we might as well listen to the radio. I turned the volume control knob, and as I did so, the light in the dining room came on. When one of the other students pulled the chain to try the lamp beside the radio, a loud woosh came from the radio along with a cloud of smoke, the house was plunged into total darkness, and the radio went off.

"I then replaced the fuse at the power meter in the basement and came back to find all lights on, but the radio was turned off with a large sign across it, "Out of Order DO NOT TURN ON". I calmly removed the sign, turned on the radio and thus proved it in normal working condition."

Can you account for these somewhat unusual happenings? The explanation will be published next month.

ELECTRONICS offers a payment of five dollars for problems used in this department. Readers are encouraged to submit likely problems (along with correct solutions) for consideration. The address is ELECTRONICS, 330 W. 42nd St., New York 36, N. Y.

Capehart

needs outstanding

RESEARCH PHYSICISTS
SR. ELECTRONIC ENGINEERS
SR. MECHANICAL ENGINEERS
ENGINEERING PHYSICISTS
CIRCUIT ENGINEERS
MICROWAVE ENGINEERS
TELEVISION ENGINEERS
VACUUM TUBE ENGINEERS
TEST EQUIPMENT ENGINEERS
FIELD ENGINEERS
ELECTRONIC TECHNICIANS

with advanced academic training and several years' experience for

RESEARCH AND DEVELOPMENT

in Radar, Servos, Computers, Receivers, Solid State Physics, Image Converters, Pulse and Timing Techniques, Special Purpose Tubes, Networks and Systems Design, Light and Electron Optics, Storage-Type Tubes, Photo-Electric Pickup Tubes, and Related Test Equipment.

Our Long Range Programs and Steady Growth Assure Permanent Employment at Excellent Salaries for Competent and Qualified Personnel.

Interested Persons are Invited to Submit Detailed Resumes of Experience and Education with Salary Requirements and Availability Date to:

The Employment Department

CAPEHART-FARNSWORTH CORPORATION

FORT WAYNE, INDIANA

CLASSIFIED **SEARCHLIGHT SECTION** ADVERTISING

EMPLOYMENT • BUSINESS • **OPPORTUNITIES** • EQUIPMENT—USED or RESALE

DESIGNERS and ENGINEERS

Large Midwestern business machine manufacturer requires services of experienced electronic and mechanical designers and engineers for product design work. Please submit references and educational background.

P-3300, Electronics
330 W. 42 St., New York 36, N. Y.

WANTED
PRODUCTION MANAGER

Industrial & Electrical Products—Company has top reputation and 400 employees—Present Manager moving up—cooperative associates — Interesting future — Excellent compensation arrangements—Please give full data including requirements and enclose recent photo.

M. G. Chamberlain & Company
Industrial Consultants
8845 West Olympic Blvd.
Beverly Hills, California

REPLIES (Box No.): Address to office nearest you
NEW YORK: 330 W. 42nd St. (36)
CHICAGO: 520 N. Michigan Ave. (11)
SAN FRANCISCO: 68 Post St. (4)

POSITIONS VACANT

WANTED—SALES Engineers for large industrial instrument manufacturer. Prefer Mechanical, Electrical or Chemical Engineers with few years industrial experience. Fine opportunity for young engineers with sales aptitude to connect with one of the fastest growing industrial instrument companies in the United States. Locations: Houston, Texas and Los Angeles, California. In addition to above we desire services of Application Engineers who will be located at factory in New England. Exceptional opportunities. P-3218, Electronics.

WANTED—AIRCRAFT Radio Technicians. Experienced installation and maintenance all types aircraft electronic, communication and navigation equipment. Write stating education, experience, and starting salary desired. Atlantic Aviation Service, Box 1709, Wilmington, Del.

EMPLOYMENT SERVICE

SALARIED PERSONNEL, $3,000-$25,000. This confidential service established 1930, is geared to needs of high grade men who seek a change of connection under conditions assuring, if employed, full protection to present position. Send name and address only for details. Personal consultation invited. Jira Thayer Jennings, Dept. L, 241 Orange St., New Haven, Conn.

POSITIONS WANTED

E.E. MOST Recent position Chief Engineer Cathode Ray Tubes. Fifteen years design and manufacturing experience receiving and transmitting tubes. Also several years experience as project engineer electro-mech products. Good administrator, excellent organizer and coordinator. Unusual business and executive ability to produce. Wish to be considered for plant manager, works manager, or comparable administrative executive position with small or medium size company. PW-3293, Electronics.

POSITIONS OPEN

Location
KANSAS CITY, MO.

Electronic & Mechanical Engineers

ELECTRONIC ENGINEERS: Must have considerable development experience in radio transmitting and receiving equipment. Ability to fill position of Senior Project Engineer a requisite.

MECHANICAL ENGINEER: Must have development experience in mechanical design of electronic or similar precise equipment. Practical and theoretical knowledge of materials, finishes, sheet metal, and machine shop design are basic requirements. Position is one of considerable responsibility.

SALARY: Open.

These positions are permanent.
Write stating educational and professional history direct to:

Jay V. Wilcox, *President*
WILCOX ELECTRIC COMPANY, INC.
1400 Chestnut St. Kansas City 1, Mo.

Dependable communications since 1931

POSITIONS WANTED

ELECTRONICS METAL Joining Engr., over 10 years experience in all phases of welding, brazing, and misc. joining. Has graduate degree, has written many technical papers, and taught courses in this field. Currently in full charge of joining activities for 5000 employee plant of major electrical concern. Can furnish unexcelled references. Desires position offering greater remuneration and supervisory rank. PW-3312, Electronics.

DEVELOPMENT AND Design experience, industrial electronic experience with use of vacuum and gas tubes, relays and automatic electronic controlled machinery. E.E. '40. PW-3330, Electronics.

PURCHASING AGENT, Asst., Electronics, 11 years exp. with jobbers, war surplus, research and defense plants; stock control & stores supervision. Vet. N. Y. area only. PW-3177, Electronics.

RADIO ENGINEER extensive domestic and foreign experience desires responsible position with aggressive company preferably foreign field. Speak and understand Spanish. PW-3232, Electronics.

SELLING OPPORTUNITY WANTED

FIELD ENGINEERING and Service Organization desires additional representations in nuclear, industrial, or medical electronics. Well established, technical personnel of highest calibre. Can work La, Miss, and Ala. Write Delta Electronics, Inc., P. O. Box 476, New Orleans, La.

WORK WANTED

Two Technical Writers
Heavy experience Radar, Sonar, Bomb directors, fire control, ordnance. Freelance work N. Y. area preferred. Good security rating. WW-3007, Electronics.

FOR SALE

For Sale.—IRE Proceedings,
1926-1941, 1947-1950. John C. O'Brien, 283 Malden Street, Rochester 13, N. Y.

Kay Electric Standard Megamatch
Used 2 months. Factory cost $695—Sacrifice $375—prepaid. Lyle Mfg. Co. Box 681, Hilo, Hawaii.

PATENTS

Consult A. John Michel.
Registered Patent Att. specializing in Electronics. 15 Park Row, New York 38, N .Y. Tel. CO-7-9034.

CONSULT: Z. H. POLACHEK
Reg. Patent Attorney, 1234 Broadway, New York 1, N. Y.

ENGINEER!

- IS YOUR WORK STIMULATING?
- ARE YOU CHALLENGED BY YOUR JOB?
- ARE YOU RECEIVING PROFESSIONAL RECOGNITION?

SYLVANIA

believes in building men

The company now in its 51st year is expanding rapidly. Net sales this year exceed 1938 by 16 times. Additional high caliber men are needed with training and experience in all phases of electronics, physics and mechanics.

Write us about yourself, if your experience and future plans fit into this picture.

Harold F. Clark
Employment Manager

SYLVANIA ELECTRIC PRODUCTS, INC.
Radio & Television Division
278 Rano Street, Buffalo 7, New York

OUTSTANDING OPPORTUNITIES FOR PERMANENT POSITIONS as Senior Electronic Engineers

In large capacitor manufacturing concern located in the East.

FILTER ENGINEER — Experienced man to take charge of research, design, development of radio noise filters and to handle all engineering problems relative to manufacture of same.

CAPACITOR ENGINEER — Capable of handling entire project of design, development and production engineering of metal cased hermetically sealed paper dielectric capacitors.

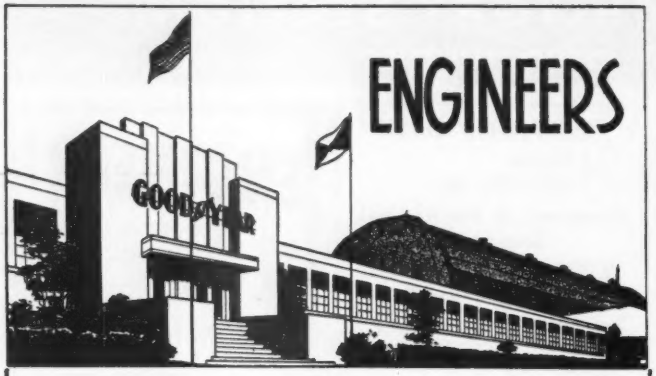
P-3198, Electronics
330 W. 42 St., New York 36, N. Y.

ELECTRON TUBE SALESMAN

Nationally known maker of electron tubes has positions open for men experienced in selling to manufacturers. General knowledge of radio and television industry is necessary. East and Midwest territories. Excellent opportunities. Give full details. Replies held strictly confidential.

Box SW-3178, Electronics
330 W 42nd St., New York 36, N. Y.

Additional Searchlight Advertisement on the opposite page



ENGINEERING WITH A FUTURE

RESEARCH • DEVELOPMENT • DESIGN

The continued and steady growth of established research and development projects has opened a number of unusual opportunities for outstanding and experienced men.

ENGINEERS • SCIENTISTS • PHYSICISTS

Positions are available in our organization for qualified personnel in the following fields:

Circuit Analysis	Aerodynamics
Microwaves	Applied Mathematics
Analog Computers	Physics
Servomechanisms	Flight Test
Dynamics	Design

Openings exist at several levels, and inquiries from recent graduates are also invited. Salaries are based on education, ability, and experience. Liberal salary, vacation, insurance, and retirement plans are yours if you qualify.

If you are interested in a secure future in these experimental fields, write and give full details to Mr. C. G. Jones, Salary Personnel Department.

GOODYEAR AIRCRAFT

GOODYEAR Aircraft CORPORATION

Akron 15, Ohio

RICO

ATTENTION!

Former Field Engineers

We urgently need men with electronic background, and preferably radar or computer experience, to supervise, instruct and assist in installation—maintenance of electronic equipment.

Excellent starting salary during factory training, plus overtime premium in field. Substantial insurance program. Overseas duty not mandatory. Salary will be commensurate with experience.

Please forward your personal experience record to:

Personnel Supervisor
Field Eng. Div.

Reeves Instrument Corp.
215 East 91st St.
New York, 28, N. Y.

PROJECT ENGINEER

For UHF Mobile Equipment

Graduate electrical engineer with a minimum of 10 years of good professional standing.

Must be thoroughly experienced in all phases of circuit development on low power transmitters and receivers in the 200 to 300 MC bands. Must have proven leadership and drive to supervise all phases of design and development of the entire project and capable of developing new components where needed. Background in sub-miniaturization an asset.

As a corporation with 50 years existence in the communication field, and with far reaching projects for the future established, we offer a steady position for the right individual. Salary is attractive and working conditions are excellent. Choice location on Long Island, close to all recreation facilities.

Contact Mr. PHILIP N. LEHR
Chief Engineer

DICTOGRAPH PRODUCTS INC.

95-25 149th Street,
Jamaica 1, L. I., New York

ELECTRONIC ENGINEERS

Degree in Electrical Engineering Plus Maintenance or Repair Experience on SCR-584 Radar

ELECTRONIC ENGINEERING COMPANY OF CALIFORNIA
180 SO. ALVARADO STREET
LOS ANGELES, CALIFORNIA

ELECTRONIC ENGINEERS
ALL GRADES

Small electronic research and development laboratory, located 8 miles outside of Washington, D. C., has several openings for junior and senior electronic engineers. Degree essential. Varied projects include analog computers, servo mechanisms, special test equipment, etc. All Defense work. Liberal salaries dependent upon experience.

THE DAVIES LABORATORIES
Incorporated
4705 Queensbury Road, Riverdale, Maryland

Engineers

(Senior—BS or MS)

With Minimum 3–5 years experience

DEVELOPMENT WORK OF REAL CHALLENGE

Design and development of Arma's intricate electronic equipment calls on every part of your training, experience, and skill.

Openings in:

GYROSCOPICS
ANALOG COMPUTERS
FIRE CONTROL SYSTEMS
SERVO MECHANISMS
INSTRUMENT DESIGN
CONTROL CIRCUITS
TECHNICAL WRITING

Additional Benefits Include:

- Salaries among the highest in industry . . . plus overtime and out-of-plant Bonuses.
- Cost of living benefits.
- Liberal pension plan.
- Company-paid Blue Cross.
- Company-paid life, health and accident insurance.
- Periodic merit reviews and merit increases.

Send Complete Details To:

Technical Personnel Office

ARMA CORP.

254 36th St. Brooklyn 32, N. Y.

ENGINEERS WITHOUT COLLEGE DEGREES...

We put *no limits* on your engineering future!!

● Are you capable of doing real professional-level engineering work? If you have demonstrated your ability to do first class engineering work but feel you are being handicapped by the lack of a college degree, get in touch with this company.

WE ARE a large manufacturer of Electronic Equipment (Military, Aviation, Automotive, Television) and have over 100-million-dollar backlog. Located on Eastern Seaboard.

● There are many responsible positions open in our organization which offer unlimited opportunity. We want them filled by competent men, regardless of their formal educational backgrounds.

P-3334, Electronics
330 W. 42 St., New York 36, N. Y.

ENGINEERS

LOCATE IN THE

Healthful Southwest

FOR ATOMIC WEAPONS INSTALLATION

Mechanical Engineers, Electronics and Electrical Engineers, Physicists, and Mathematicians. A variety of positions in research, development and production open for men with Bachelors or advanced degrees with or without applicable experience.

These are permanent positions with Sandia Corporation, a subsidiary of the Western Electric Company, which operates the Laboratory under contract with the Atomic Energy Commission. The Laboratory offers excellent working conditions and liberal employee benefits, including paid vacations, sickness benefits, group life insurance and a contributory retirement plan.

Land of Enchantment

Albuquerque, center of a metropolitan area of 150,000, is located in the Rio Grande Valley, one mile above sea level. The "Heart of the Land of Enchantment," Albuquerque lies at the foot of the Sandia Mountains which rise to 11,000 feet. Cosmopolitan shopping centers, scenic beauty, historic interest, year 'round sports, and sunny, mild, dry climate make Albuquerque an ideal home. New residents experience little difficulty in obtaining adequate housing in the Albuquerque area.

Make application to the

PROFESSIONAL EMPLOYMENT DIVISION

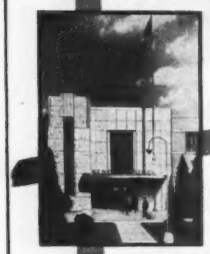
SANDIA

Corporation

SANDIA BASE

ALBUQUERQUE, N. M.

MAKE THIS YOUR HOME FOR IMPORTANT WORK UNDER IDEAL CONDITIONS



- TV RECEIVER DESIGN ENGINEERS
- ELECTRONICS ENGINEERS
- FIELD ENGINEERS
- TEST & INSPECTION ENGINEERS
- LAB. TECHNICIANS

NEEDED TO WORK ON: Radar, G.C.A., Mobile Radio, Auto Radio, Airborne Communication & Navigation Equipment, Television, Antennas, Microwave Equipment, Servo Mechanisms, Guided Missiles and Test Equipment Design.

YOU BENEFIT AT BENDIX RADIO: from high wages, a modern, air-conditioned plant, paid vacations and holidays, group insurance and a good chance for advancement.

Housing immediately available in the beautiful suburban and country areas that surround the Bendix Radio plant.

Write, Wire or phone
MR. E. O. COLE, DEPT. J. **Bendix Radio**
DIVISION OF BENDIX AVIATION CORPORATION
BALTIMORE-4, MD. Phone: TOWSON 2200
Makers of the World's Finest Electronic Equipment

Wanted
ENGINEERS
AND
SCIENTISTS

Unusual opportunities for outstanding and experienced men.

These top positions involve preliminary and production design in advanced military aircraft and special weapons, including guided missiles.

Immediate positions include:

Weight-control engineers
Electronic project engineers
Electronic instrumentation engineers
Radar engineers
Flight test engineers
Stress engineers
Aero- and thermodynamicists
Servo-mechanists
Power plant installation designers
Structural designers
Electro-mechanical designers
Electrical installation designers

Excellent location in Southern California. Generous allowance for travel expenses.

Write today for complete information on these essential, long-term positions. Please include resume of your experience & training. Address inquiry to Director of Engineering.

NORTHROP AIRCRAFT, INC.
1009 E. Broadway
Hawthorne (Los Angeles County) California

AC SPARK PLUG DIVISION
of
GENERAL MOTORS CORPORATION

PRECISION INSTRUMENT PLANT

Positions now available for highest caliber personnel in the field of airborne automatic electro-mechanical control equipment.

MECHANICAL DESIGN ENGINEERS
ELECTRONIC ENGINEERS
SERVO ENGINEERS
ELECTRONIC DESIGNERS
MECHANICAL DESIGNERS

New and expanding division of an established firm with 20 years of successful experience in the instrument field. Work involved deals with the manufacture and development of highly complex equipment of the most advanced type.

Write or Apply

AC Spark Plug Division
GENERAL MOTORS CORPORATION
1925 E. Kenilworth Place
Milwaukee 2, Wisconsin

ENGINEERS
Electronic & Electro-Mechanical
and **DESIGNERS**

Make Your Move In the Right Direction

POSITIONS THAT POINT TO A SUCCESSFUL FUTURE!

Minimum Requirements for **ENGINEERS**

Four years' experience in advanced research and development on Radar Systems, Computers, Wave Guide and Antennas, Fire Control, Moving Target Indication, Servo-mechanisms, Pulse Techniques, Gyroscopic Equipment and Related Fields.

Minimum Requirements for **DESIGN ENGINEERS**

Background-Experience in design of Light Machinery, Radar Systems, Computers, Moving Target Indicators, Servo-mechanisms, Gyroscopic Equipment and Related Fields.

If your skills are now being fully utilized in a vital defense industry, please do not apply.

Kindly send resume and salary requirements to

The **W.L. MAXSON CORPORATION**
460 W. 34th St. New York 1, N. Y.

CORNELL AERONAUTICAL LABORATORY, INC.
an affiliate of Cornell University

employs about 700 people on vital research work in all branches of aeronautical science. We are gradually expanding our scientific staff, and have several permanent positions open for:

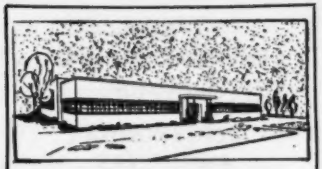
ELECTRONICS ENGINEERS
PHYSICISTS
MECHANICAL ENGINEERS
AERODYNAMICISTS
AERONAUTICAL ENGINEERS
CHEMICAL ENGINEERS

in such fields as:

GUIDED MISSILES
RADAR RESEARCH
BASIC AND APPLIED PHYSICS
ELECTRONIC COMPUTERS
SYSTEMS ANALYSIS
AIRCRAFT PRECISION INSTRUMENTATION
WIND TUNNEL RESEARCH
FLIGHT RESEARCH
DEVELOPMENT ENGINEERING
HEAT TRANSFER
THERMODYNAMICS

Minimum requirement is a B.S. Advanced degrees are even better, but experience to back up the degree is really best. We pay industrial salaries. Other tangible advantages here (for example, our self-sponsored internal research policy) should be of particular interest to men with intelligence, ingenuity, and initiative. Send us your resume; all inquiries are strictly confidential. Promising candidates will be invited to Buffalo for interviews at Laboratory expense.

CORNELL AERONAUTICAL LABORATORY, INC.
P. O. Box 235 Buffalo 21, New York



LOOKING AHEAD?

If you're a top performer in the field of physics, electronic engineering or design, and you're looking for a career as well as a well-paid position, it will pay you to investigate the excellent opportunity we offer.

• • •

BASIC QUALIFICATIONS: Minimum of four year's experience in advanced research or development related to:

- PULSE CIRCUITS
- COMPUTERS
- NUCLEAR INSTRUMENTS
- MINIATURIZATION

• • •

ILLUSTRATED BROCHURE on request. Please write (giving summary of your education and experience, plus salary requirements) to:

THE BERKELEY SCIENTIFIC CORP.
2200 Wright Avenue
RICHMOND, CALIFORNIA

ELECTRONIC ENGINEERS

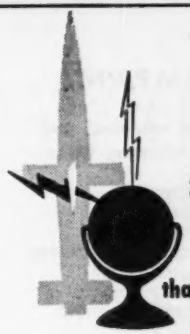
Electronic Engineers qualified by design experience on DC and wide band amplifiers, low power pulse circuitry, computers, telemetering or allied fields, should contact Tracerlab, Inc.

Tracerlab manufactures instruments of all types for the fast growing field of radioactivity and as one of the foremost leaders in this field, has much to offer its employees concerning security and fine opportunities for advancement.

Engineers who have had responsibility for design of electronic instruments in a manufacturing organization with supervision of Junior Engineers and Technicians are invited to write, giving a detailed outline of training and experience. Correspondence will be confidential. Selected applicants will be asked to come to Boston at our expense for interview.

Industrial Relations Department

TRACERLAB, INC.
130 High Street Boston 10, Mass.



ENGINEERS

Special opportunities for YOU in

SAN DIEGO

that sunshiny, smog-free city on the coast of

CALIFORNIA

Convair (Consolidated Vultee Aircraft Corporation) is now accepting applications for these following positions in its modern, progressive Engineering Department.

Microwave Engineers
Servomechanism Engineers
Electronics System Engineers
Electronic Circuit Designers

Unusual opportunities for those experienced in the design and analysis of Radar and Missile Guidance Systems.

WORKING FACTS: You get two holidays a week at Convair — overtime accomplished in 5-day week. Attractive salary ranges. An "engineers" engineering department . . . with stimulating, competent associates . . . and interesting, challenging, essential, long-range projects of a wide variety including — commercial aircraft, military aircraft, missiles, engineering research and electronic development. Excellent patent royalty arrangements. Top-notch retirement plan — better than-average life and health insurance. Complete progress-salary review for each person twice yearly. Opportunity for continuing engineering education.

LIVING FACTS: San Diego, with its wonderful residential areas, offers you and your family incomparable living. Ideal climate — cool, clean, dry. Mountains, desert, Mexico, Hollywood, Los Angeles, Pacific Ocean, beaches and bay — only hours or minutes away. It offers you a new way of Life . . . pleasant, refreshing, happy.

If you qualify, you will receive generous travel allowances.
SEND COUPON **for free booklets and complete information.**

THANK YOU
Mr. H. T. Brooks, *Engineering Department* 900
Convair, 3302 Pacific Hiway, San Diego, California
Please send me ***FREE*** booklets describing the Convair Opportunity for me and my Convair Application Form.

My name_____
Occupation _____
Address_____
City_____ State_____

COLLINS RADIO COMPANY . . .

has excellent opportunities for electrical and mechanical engineers in the following fields:

RADIO COMMUNICATIONS	COMPUTERS
RADIO NAVIGATION	GUIDED MISSILES
SERVO MECHANISMS	AUTO PILOTS
GYROS	AIRCRAFT INSTRUMENTS
ELECTRONICS	SPECIFICATIONS
RADAR	QUALITY CONTROL
COUNTER MEASURES	TECHNICAL WRITING

● See Glenn G. Johnson or W. H. Bigger of the Collins Radio Company at the Waldorf Astoria during the IRE Convention in New York.

An association with Collins brings many advantages—opportunity to the limit of your capacity, salary commensurate with your ability, low cost insurance, hospitalization and surgical service. Selected applicants will be given trips to Cedar Rapids for interview. The requirement is a BS degree in an accredited four-year school.

COLLINS RADIO COMPANY
Cedar Rapids, Iowa
NEW YORK • DALLAS • BURBANK

STAVID ENGINEERING, INC.

has openings for Graduate

ELECTRONIC ENGINEERS

MECHANICAL ENGINEERS

Experience in Design and Development of Radar and Sonar necessary.

Broad knowledge of Search and Fire Control Systems; Servo Mechanisms, Special Weapons, Microwave, Antenna and Antenna Mounts, etc.

Mechanical Engineer should also have experience in packaging of Electronic Equipment to Gov't specifications including design of complex cabinets, shock mount and sway brace structures, Servo Mechanisms.

Positions are available in Field Service and Technical Writing.

Liberal personnel benefits including life, sickness and accident insurance, and a worthwhile pension system. Paid holidays and vacations.

Personnel Office
312 Park Ave.
Plainfield, N. J.
Telephone Dunellen 2-1400

SALES ENGINEER

Long established Precision Electronic Instrument Manufacturer plans permanent program of technical market research and customer contact. Program includes other interesting technical sales assignments.

Salary will be commensurate with ability. We are located in a desirable residential area. You will find room to expand your abilities in our organization. Please send resume of education and experience to Sales Manager.

Position requires man with B S in E E or equivalent and 6 to 10 years' experience in one or more of the following: ELECTRONIC INSTRUMENT DESIGN OR DEVELOPMENT, GENERAL ELECTRONIC SYSTEMS OR CIRCUIT ENGINEERING, TECHNICAL SALES ENGINEERING.

BOONTON RADIO CORP.
BOONTON, N. J.

WANTED ELECTRONIC ENGINEER

Excellent position in expanding corporation for a man who can take charge of the development of electronic instruments for the geophysical field. Practical engineer, preferably geophysical, theoretical background in low-frequency networks and amplifier design, and at least a B.S. in EE required. This is a top opportunity for a man with initiative.

Reply, in full detail, to:

Chief Engineer

Century Geophysical Corporation
1339 North Utica Tulsa, Okla.

OUTSTANDING OPPORTUNITIES FOR PERMANENT POSITION as Mechanical Engineer

In large capacitor manufacturing concern located in the East. Executive ability to direct designers and draftsmen in preparation of manufacturing specifications of paper dielectric capacitors, pulse networks and radio noise filters.

P-3201, Electronics
330 W. 42 St., New York 36, N. Y.

Aeronautical

Operators—Technicians—Electronic Engineers
Excellent opportunity with 20-year aeronautical communications firm for FCC licensed fone and telegraph operators and technicians. Also need advanced technicians and practical research personnel (licenses not required) for quality control work in electronics. Domestic and foreign assignments available—liberal foreign allowance. Ham background desirable.
Box 2802—Washington 13, D. C.

ENGINEERS - TRANSFORMER

Opportunity—Capable Men

Well established Chicago Concern has excellent opportunities in both Chicago and Southern California plants for qualified engineers experienced in Transformer design and development, particularly in the hypersil type. Must be familiar with Mil T 27 specifications. Salary commensurate with ability. Our employees know of this ad. Please send resume to Director of Personnel.

P-3304, Electronics
330 W. 42 St., New York 36, N. Y.

OPPORTUNITIES FOR EXPERIENCED

ELECTRON TUBE ENGINEERS

RAYTHEON MFG. COMPANY
SPECIAL TUBE SECTION

JOIN THIS ESTABLISHED ORGANIZATION AND BECOME A PART OF THEIR LONG RANGE EXPANSION PROGRAM. PLANT LOCATED IN RESIDENTIAL SUBURB OF BOSTON, THE EDUCATIONAL AND INDUSTRIAL HEART OF NEW ENGLAND.

- EXCELLENT OPPORTUNITIES TO IMPROVE FORMAL EDUCATION
- PERIODIC SALARY AND PROMOTION REVIEW
- HOSPITALIZATION & MEDICAL INSURANCE
- RETIREMENT PROGRAM
- EXCELLENT LIVING CONDITIONS
- SALARIES COMMENSURATE WITH ABILITY

MINIMUM REQUIREMENTS:

1. At least two years' experience, or equivalent, in electron tube manufacture, design, research or development.
2. Outstanding record of achievement in this field.

If interested, send complete resume, including salary expected, to:

G. W. Lewis, Personnel Mgr.
RAYTHEON MFG. COMPANY
RECEIVING TUBE DIVISION
55 CHAPEL STREET
NEWTON 58, MASS.

ELECTRONIC COMPONENTS SPECIALIST

Graduate engineer thoroughly experienced in design and production of electronic components, such as capacitors, resistors, transformers, etc., to consult and engage in full-time research in broad field of electrical engineering. Unusual opportunities for professional growth and advancement in large progressive research organization. Prompt, confidential handling of all applications. Please reply directly to

BATTELLE MEMORIAL INSTITUTE
505 King Avenue
Columbus 1, Ohio

ELECTRONIC PROJECT ENGINEER

An opening for a Project Engineer to take over, after an indoctrination period, the direction of a major sonar development, is now available. A first class background in electronic design with at least 2 years experience as a project or assistant project engineer on a military electronic project is required. Sonar experience is desired but is not necessary. Our sonar activity is expanding both in commercial and military applications and offers an excellent opportunity for a qualified man. Please contact P. J. Lyon, Pacific Division.

BENDIX AVIATION CORP.
North Hollywood, Calif.

engineers... physicists... chemists... metallurgists...

GENERAL ELECTRIC

Can Mean A Turning Point in Your Career

In terms of personal satisfaction, assured professional advancement, diversification, and prestige, you can give new impetus to your career through these positions now open with General Electric in: Advanced Development, Design, Field Service, and Technical Writing, in connection with:

MILITARY RADIO & RADAR
MOBILE COMMUNICATION
MULTIPLEX MICROWAVE
COMMUNICATIONS
ELECTRONIC COMPONENTS
TELEVISION, TUBES and ANTENNAS

Bachelor's or Advanced Degree in Electrical or Mechanical Engineering, Physics, Metallurgy or Physical Chemistry and/or experience in the Electronics industry necessary.

Please send resume to:
DEPT. 23A, TECHNICAL PERSONNEL
ELECTRONICS PARK

GENERAL ELECTRIC
SYRACUSE, N. Y.

ELEC. ENGRS. AND PHYSICISTS

Need scientific personnel for developmental work pertaining to balloons. Prefer advanced degrees and some research experience involving communications, instrumentation, telemetering, servomechanisms, gas generation, low temperature research, flight operations, or related problems. Salaries commensurate with experience. Liberal employee benefits, including moving expenses both ways. Submit details of background to:

Employment Bureau
Rm. 17, Adm. Bldg.
University of Minnesota
Minneapolis 14, Minn.

METERS

1 MA DC 3½" R Dejur Mod 310 (0-4KV scale) ..$5.75
3MA DC 2½" R—Simpson black scale..... 3.35
500 Microamps, DC—2½" round—Sun..... 4.50
1ma. DC Fan type—4" scale (ram. from equipt) 3.95
500 ma. DC 2½" R.—General Electric..... 2.95
2 amp. RF 2½" Sq.—Simpson 3.15
5 amp. AC 4½" R.—IBT 4.11
30 V DC 2½" R—General Electric..... 3.95
3 amp. RF 3½" R.—Weston..... 6.00

OIL-FILLED 35 KV AND 50 KV ISOLATION TRANSFORMERS

Pri. 460V 60 cy. Sec. 115V 290 VA insulated for 50KV DC—G. E. Form EIR—29"H x 13" D.....$125.00
Pri. 115V 60 cy. Sec. 115V 250 VA insulated for 35 KV DC—G. E. Form EIR—29"H x 12½"D $125.00

VOLTAGE DIVIDER

G.E. Cat. 82488860-1 and 90018346-1 17,248,400 ohms 35KV 70:1 ratio wire wound shielded oil-filled 40"H x 12"D.....$77.50

2 φ LOW INERTIA SERVO MOTORS

DIEHL Type FPE 25-11 75 Volt 60 cycle 4 watts—new $34.50
KOLLSMAN—45 Volt 60 cycle 4 watts 1500 RPM—new $22.50

OIL FILLED CONDENSERS

MFD	VDC	Price	MFD	VDC	Price
2	400	$.55	3	2000	3.75
5-5	400	1.65	12	2000	6.95
1	400	.55	1	2500	2.75
2	400	.95	1	2500	3.50
2	400R'd	.69	32	2500	15.50
2-2	400R'd	1.45	.5	3000	2.40
3	400	.95	2	3000	4.50
4	400	1.45	.03	4000	1.25
4	400R'd	1.45	2 x .2	4000	2.95
5	400	1.75	3	4000	6.95
6	400	1.85	1	5000	1.60
8	400R'd	1.85	.3	5000	2.50
8-8	400	1.95	1	5000	4.85
4-4-4	400	2.50	.01-.03	5000	1.65
4 x 3	400	2.50	.1	7000R'd	1.79
1	1000	.45	.1	7500	2.85
2	1000	.75	.1-.1	7500	5.95
2	1000R'd	.95	1	7500	12.50
3.5-.5	1000	1.85	.075-.075	8KV	6.50
4	1000	1.95	.1	12KV	8.95
8	1000	2.50	.045	16KV	4.79
8	1000	3.25	.05	16KV	4.95
1	1200	.85	.075	16KV	8.95
1-1-1	1500	1.85	.25	20KV	19.95
.1	1500	.59	1-3	330VAC	1.95
.5	1500	1.25	10	330VAC	3.95
3	1500	2.50	13.75	330VAC	4.10
4	1500	2.95	15	330VAC	4.50
.1-.5	2000	.95	5	440VAC	3.10
.25	2000	1.50	2.9	660VAC	3.50
.5	2000	1.50	7	660VAC	4.2
1	2000	1.95	8	660VAC	4

OILMITES

MFD	VDC	TYPE	Price
.02	600	OM-6002	$ .45
.05	600	OM-6005	.48
.1	600	OM-610	.51
.25	600	OM-625	.58
.5	600	OM-650	.69
1.0	600	OM-601	.85

HIGH VOLTAGE TRANSFORMERS

G.E.—Pri. 115V 60 cy. Sec. 6250V 80 MA—12.5 KV Insulation $18.50
G.E.—Pri. 115V 60 cy. Sec. 6250/5850/2000V 80 MA 12.5 KV Insulation $18.50
Raytheon—Pri. 115V 60 cy. Sec. 6500/6450V CT 45 MA Hermetically sealed $22.50

ANTENNAS

AT-38A/APT (70 to 400MC).....$13.78
AT-48/APR-4 (300 to 3300MC)..... 13.70
AN-74B (125 to 150MC)..... 3.25
AN-68A (P/O SCR-521)..... 1.50
AN-96A (P/O SCR-521)..... 1.75
A1A-3CH conical scan..... 125.00
ASB Yagi—5 element 450 to 560MC..... 7.90
ASD Yagi—Double stacked 5 element..... 12.70
ASA Yagi—Double stacked 370 to 430MC..... 28.40

RELAYS

Sigma type 4AH—2000Ω 4 ma DC coil—SPDT contacts—hermetically sealed 5 pin plug-in base $5.50
Sigma type 4R—6000Ω 1 ma DC coil—SPDT contacts—enclosed type 5 pin plug-in base..... $4.25
Stevens Arnold type 171 Millisec relay—900 ohm coil—SPST NO contacts $5.50
Cutler-Hammer and Square D type B-7A contactor—24 VDC coil—SPST NO 200 Amp contacts...$4.75
Price Bros. type 161-M—220 VAC contactor—SPST NO momentary bk. 30A contacts..... $3.25
G.E. CR5181-1AG—115 V 60 cy. AC contactor—4PST 30 Amp contacts plus two auxiliary SPDT contacts $14.50
RBM—115 V 60 cy. AC coil—DPDT 3 Amp contacts $3.20
Leach type 182I—115 V 60 cy. AC coil—SPST NO double bk. 15 Amp contacts—mycalex insul...$3.25
Cramer type 1C2H—110 V 60 cy. interval timer—two SPST 15 Amp contacts (on 1 hr. off 1 hr.)... $3.95
Sworll 1821 vacuum relay switch (for AN/ART-13) $9.50
G.E. 501 vacuum relay switch SPDT 15 Amp contacts $3.50

Terms 20% cash with order, balance C. O. D. unless noted. All prices net F.O.B. our warehouse, Phila., Penna., subject to change without notice.

COAXIAL CONNECTORS

83-1AC	$ .42	83-1RTY	$ .45	83-22R	$ .48
83-1AF	.30	83-1SP	.50	83-22SP	1.15
83-1F	1.30	83-1SPN	.60	83-22T	1.95
83-1H	.10	83-1T	1.30	83-168	.15
83-1HP	.25	83-2AP	1.95	83-185	.15
83-1J	.80	83-22AP	1.40	83-765	.24
83-1R	.40	83-22F	2.10	83-776	.85
		83-22J	1.50		

FULL LINE OF JAN APPROVED COAXIAL CONNECTORS

IN STOCK

UHF—N—PULSE—BN—BNC

UG-7/AP	$6.30	UG-83/U	$1.85	UG-185/U	$1.60
UG-13/U	.95	UG-85/U	1.75	UG-191/AP	.90
UG-15/U	1.50	UG-86/U	2.50	MX-196/U	.75
UG-18/U	1.25	UG-87/U	1.60	UG-197/U	2.80
UG-19/U	1.80	UG-88/U	1.85	UG-201/U	1.95
UG-21/U	.95	UG-89/U	1.60	UG-203/U	.85
UG-21A/U	1.50	UG-90/U	1.60	UG-206/U	1.80
UG-21B/U	1.35	UG-98/U	1.85	UG-224/U	1.40
UG-22/U	1.35	UG-102/U	1.15	UG-236/U	2.85
UG-22B/U	1.65	UG-103/U	.68	UG-345/U	2.30
UG-23/U	1.30	UG-104/U	1.40	UG-264/U	2.75
UG-23B/U	1.90	UG-106/U	.15	UG-255/U	2.45
UG-24/U	1.30	UG-108/U	2.60	UG-260/U	1.35
UG-25/U	1.35	UG-109/U	2.60	UG-261/U	1.60
UG-27/U	1.30	UG-146/U	2.85	UG-262/U	1.90
UG-27A/U	2.95	CW-159/U	.60	UG-273/U	2.25
UG-29/U	1.65	UG-166/U	$2.50	UG-274/U	2.75
UG-30/U	2.30	UG-167/U	5.85	UG-275/U	5.50
UG-34/U	16.50	UG-168/U	2.50	UG-276/U	2.75
UG-36/U	17.50	UG-175/U	.40	UG-290/U	1.35
UG-37/U	17.50	UG-176/U	.16	UG-291/U	1.75
UG-57/U	2.80	UG-177/U	.40	UG-306/U	2.95
UG-58/U	.80	UG-177/U	.24		

QUOTATION UPON REQUEST ON ANY CONNECTORS NOT LISTED HERE

M-358	MC-277	PL-259A	PL-326
M-359	MC-320	PL-274	SO-239
M-359A	PL-258	PL-284	SO-284
M-360	PL-259	PL-295	TM-201
93-C	49120	D-163950	ES-685696-5
93-M	49121A	D-166133	ES-689175-1

COAXIAL CABLE

Type	Price Per M Ft.	Type	Price Per M Ft.
RG-5/U	$140.00	RG-22/U	$150.00
RG-6/U	180.00	RG-22A/U	285.00
RG-7/U	85.00	RG-24/U	675.00
RG-8/U	135.00	RG-26/U	475.00
RG-9/U	250.00	RG-29/U	50.00
RG-9A/U	275.00	RG-34/U	300.00
RG-10/U	240.00	RG-35/U	900.00
RG-11/U	135.00	RG-54A/U	97.00
RG-12/U	240.00	RG-55/U	110.00
RG-13/U	216.00	RG-57/U	325.00
RG-17/U	650.00	RG-58/U	65.00
RG-18/U	900.00	RG-58A/U	80.00
RG-19/U	1250.00	RG-59/U	75.00
RG-20/U	1450.00	RG-62/U	75.00
RG-21/U	220.00	RG-77/U	100.00

ADD 25% TO PRICES SHOWN FOR QUANTITIES UNDER 500 FT.

CRYSTAL DIODES

1N21	$1.19	1N23	$1.95	1N34	$ .79
1N21A	1.49	1N23A	2.25	1N34A	.95
1N21B	4.00	1N23B	5.25	1N45	.94
1N22	$1.09	1N27	1.79	1N52	1.05

TYPE "J" POTENTIOMETERS

Resis.	Shaft	Resis.	Shaft	Resis.	Shaft
50	SS	5K	1/4"	50K	3/8"
50	9/16"	5K	3/8"	50K	1/2"
100	SS	5K	1/2"	100K	SS
200	SS	10K	SS	150K	1/2"
250	1/8"	10K	3/8"	200K	3/8"
500	SS	10K	1/2"	250K	SS
500	5/16"	15K	SS	250K	3/4"
500	1/2"	15K	1/2"	250K	3/8"
500	5/8"	20K	SS	500K	SS
500	1/2"	25K	SS	500K	1/4"
1K	SS	25K	1/4"	500K	7/16"
2K	3/8"	30K	1 1/8"	1 Meg	SS
2500	SS	40K	SS	2.5 Meg	SS
4K	SS	50K	SS	5 Meg	SS
5K	SS	50K	1/4"		

DUAL "JJ" POTENTIOMETERS

50	SS	500	SS	1 Meg	SS
100	SS	1K	SS	2.5 Meg	SS
200	SS	2500	SS	5 Meg	SS
330	SS	10K	SS	1K/25K	3/8"

TRIPLE JJJ POTENTIOMETERS

100K/100K/100K—¾" 20K/150K/15K—¾"

SOUND POWERED TELEPHONES

U. S. NAVY TYPE M HEAD AND CHEST SETS
U.S.I. A290 W.E. D-173013
A.E. GL832BAO
ANY TYPE—$14.88 EACH
TS-10 Type Handsets .....$3.92 ea.

GENERATORS AND INVERTERS

Eclipse-Pioneer type 716-3A (Navy Model NEA-3A) Output-AC 115V 10.4A 800 to 1400cy. 1φ; DC 30 Volts 60 Amps. Brand new.....$350.00
Eclipse-Pioneer type 1238-1A. Output-30 Volts DC 15 Amps. Brand New-Original Packing.....$15.50
PE-218 Inverters-28 VDC to 115 VAC 400 cy 1500 VA. (New) $90.50
G. E. 5D21N3A Inverter-24 VDC to 115 VAC 400 cy 485 VA (New) $32.50
Pioneer Type 800-1B Inverter-28VDC to 120V 800 cy 7 amp AC (used).....$22.65
G. E. Inverter-28VDC to 120 VAC 800 cy 750 VA 1φ $30.50
ATR Inverter 6VDC to 110 VAC 60 cy 75W.....$22.95
PU-7/AP Inverter-28VDC to 115 VAC 400 cy 2500 VA (used) $75.00
Eclipse Pioneer type 12121A Inverter—Voltage and frequency regulated—24VDC 18 Amp input—AC output 115V 3φ 400 cy 250VA 0.7 PF—(New) $225.00

TEST EQUIPMENT

- Gen. Radio 473B Frequency Monitor....*$200.00
- Gen. Radio 681A Freq. Deviation Meter..*$97.50
- I-222A Signal Generator *$179.50
- I-72K Signal Generator *$48.50
- C-D Guletone Filter Type IF-16 110/220V AC/DC 20 Amp *$9.00
- TS-127/U Freq. Meter w/spares.....*$65.50
- TS-143/CPN Oscilloscope *$85.00
- Dumont 175A Oscilloscope *$225.00
- Gen. Radio 757-P1 Power Supply.....*$27.00
- TS-6/AP Frequency Meter *$42.00
- I-130A Signal Generator *$85.00
- A. W. Barber Labs. VM-25 VTVM.....*$45.00
- TS-10A/APN Delay Line Test Set *$45.00
- TS-19/APQ-5 Calibrator *$75.00
- CW1-60AAG Range Calibrator for ASB, ASE, ASV and ASVC Radars *$35.00
- CRV-14AAS Phantom Antenna for Transmitters up to 400 MC *$11.75
- 3 CM Pickup Horn Antenna AT-48/UP. *$8.95
- I-138A Signal Generator—10 cm.....*$125.00
- BC-221 Frequency meter *$90.00
- BC-221 Freq. Meter (late models).....*$125.00

All Items New Except Where noted * (Exs. Used Condition

MISCELLANEOUS EQUIPMENT

I-22F Solsyn Indicator $6.95
SCR-515 compl. w/dynamotor, control box.....$9.50
Amperex IB98 Gamma Counter.....$.97
Powerstat 1226—115/230V input—0-270V out @ 9 amp $7.00
EIMAC 35T Ionization Gauge.....$.95
R-7/APS-2 Receiver $9.50
R-79/APS-15 Receiver $9.50
FL-8 1020 cycle filter.....$.95
RM-29 remote control unit.....$.95
RM-14 remote control unit.....$.95
RTA-1B 12/24 V dynamotor.....$9.00
BC-1206-CM2 Receiver $2.95
CY-230/MPG-1 Radar Console.....$75.00
ASB-4 Radar equip. Complete.....$8.75
RCA AVR-15 Beacon Recvr.....$9.50
Navy SD-3 Radar complete $200.00
Navy DP-14 Direction Finder complete.....$85.00

PULSE TRANSFORMERS

UTAH 9262, 9278, 9280

UTAH 9318, 9340, 9350

G.E. 68G-627	Westinghouse 232-AW2
G.E. 68G628	Westinghouse 232-BW-2
G.E. 68G629G1	AN/APN-4 Block Osc.
G.E. 80G13	Philco 352-7149
G.E. K-2480A	Philco 352-7150
G.E. K-2744B	Philco 352-7071
AN/APN-9 (901786-501)	Philco 352-7178
AN/APN-9 (901756-502)	Raytheon UX-7350
AN/APN-9 (352-7250)	W.E. D-161310
AN/APN-9 (382-7251)	W.E. D-163247
Westinghouse 132-AW	W.E. D-163328
Westinghouse 130DW2F	W.E. D-164481
Westinghouse 187AW2F	W.E. KS-9563

AN/APA-23 RECORDER

Sweeps any receiver through its tuning range and permanently records frequency and time of received signals on paper chart. Power input—(motor) 27V DC 1.5A, and (recorder) 80/115V AC 60-2000 cy 135W.

Originally designed to record pulse or sine-wave modulated signals received by AN-APR-1, AN/APR-2, AN-APR-4, AN/APR-5, BC-348, S-27, SX-28. BRAND NEW $147.50

SPRAGUE PULSE NETWORKS

7.5 E3-1-200-67P, 7.5 KV, "E" Circuit 1 Microsec. 200 PPS 67 ohms Imped, 3 sections.....$4.30
7.5 E3-3-200-67P, 7.5 KV, "E" Circuit 3 microsec. 200 PPS, 67 ohms Imped, 3 sections.....$6.75
7.5 E4-16-60-67P, 7.5 KV, "E" Circuit 4 sections, 16 microsec. 60 PPS, 67 ohms Imped.....$8.25
15 E4-.91-400-50P, 15KV, "E" circuit .91 microsec. 400 PPS, 50 ohms Imped, 4 sections.....$16.50
15-A-1-400-50P, 15KV, "A" Circuit, 1 microsec. 400 PPS, 50 ohms Imped.....$37.50

ELECTRONIC RESEARCH LABORATORIES
715-19 ARCH ST. PHILA. 6, PA.
Telephones - MARKET 7-6771-2-3

LECTRONIC RESEARCH

GUARANTEED BRAND NEW

STANDARD BRANDS ONLY

TUBE SPECIALS

Receiving Tubes																							
OOA	$1.50	6AG7	1.59	6SK7	.89	14A7	1.09	3FP7	4.95	1904	13.95	4B28/		WE-257A	3.77	806	2.50
01A	.67	6AH6	1.56	6SK7GT	.89	14B6	1.09	3GP1	4.95	2050	1.80	EL-6CF	8.95	WE-271A	6.75	807	1.70
1A3	.74	6AJ5	2.50	6SL7GT	1.05	14B8	1.09	3HP7	4.95	2051	1.15	4K27	17.35	WE-275A	6.95	809	2.65
1A5GT	.74	6AK5	1.85	6SN7GT	.89	14C5	1.29	4AP10	4.75	5545	32.50	4J36	150.00	WE-283A	6.25	809	2.60
1A7GT	.72	WE-6AK5	2.95	6SN7WGT	2.30	14C7	1.15	5AP1	5.95	Transmitting & Special Purpose Tubes		4J38	120.00	WE-285A	8.57	810	10.95
1A8GT	.72	6AK5W	3.05	6SQ7	.75	14E6	1.09	5AP4	4.75			4J50	275.00	WE-286A	7.90	811	3.60
1A3	.99	6AK6	.99	6SQ7GT	.75	14E7	1.29	5BP1	5.75			4J52	400.00	WE-295A	6.75	812	3.60
1A5GT	.72	6AL5	.69	6SR7	.81	14F7	1.09	5BP4	5.75			5D21	26.50	WE-301A	5.95	814	3.95
1A6	.99	6AL5W	2.90	6SS7	.99	14H7	1.15	5CP1	4.95	OA2	$1.69	5J23	24.50	304TH	15.00	815	2.75
1A7GT	1.10	6AQ5	.89	6ST7	1.25	14J7	1.29	5CP7	4.95	OA3	1.51	5J29	115.00	307A	5.50	825	1.45
1AB5	.96	6AQ6	.79	6T7G	1.09	14N7	1.29	5FP7	4.95	OB2	1.88	C6A	5.75	307A	5.50	826	1.45
1B3GT	.99	6AR5	.79	6T8	1.20	14R7	1.29	5HP1	5.75	OB3	1.15	6-4B	.85	WE-309A	6.45	828	13.48
1B4P	1.17	6AU5	.89	6U5	1.19	14W7	1.29	5HP4	5.75	OC3	1.20	6AN5	5.95	WE-310A	7.50	829	4.60
1C5GT	.99	6AS6	3.30	6U7G	.88	14X7	1.29	5JP1	26.50	OD3	1.15	6AR6	3.35	WE-313C	4.15	829A	14.90
1C6	.69	6AS7G	4.83	6V6	1.60	19	.89	5JP2	26.50	1B21A	2.85	6C21	29.50	316A	.89	829B	14.90
1C7G	.69	6AT6	.69	6V6G	.79	19T8	1.16	5JP4	26.50	1B22	3.25	6C24	52.50	327A	4.25	830B	3.95
1D8GP	.69	6AU6GT	1.32	6V6GT	.79	22	1.16	5LP1	19.75	1B23	9.95	6J6	7.95	WE-331A	9.75	832	7.95
1D7G	.69	6AU8	.69	6W4GT	.72	24A	.79	5LP5	19.75	1B24 (West)	12.95	7-7-11	1.19	WE-343A	185.00	832A	9.95
1D8GT	1.17	6AV6	.63	6W6GT	.99	28A6	1.16	5MP1	19.65	1B24 (Sylv)	18.95	10T1	.88	WE-346A	2.75	836	3.80
1E5GP	1.17	6BD6GT	1.60	6X4	.59	28L4GT	1.29	7BP1	8.75	1B26	3.75	10Y	.88	350B	1.95	837	1.85
1F6	.69	6B5	1.20	6X5GT	.89	28Z5	.99	7BP7	7.95	1B29	3.90	13-4	.80	354C	19.50	838	3.25
1F8G	.69	6B7	1.19	6Y6G	1.19	36	.79	7BP12	14.95	1B32	3.95	15E	2.35	WE-356B	5.45	841	.49
1F8	.89	6B8	.99	6ZY5G	.89	37	.69	7BP14	14.95	1B35	12.50	15R	2.35	361A	4.75	842	.49
1G4GT	.69	6B8G	.85	7A4	.89	38D7	1.75	7CP1	14.95	1B36	12.50	REL-21	2.25	371A	.95	845	5.75
1G8G	.69	6BA6	.72	7A5	1.05	38	.72	9GP7	12.85	1B38	32.50	24G	1.85	371B	.99	849	29.50
1G4GT	.69	6BA7	1.20	7A6	.85	38 Spec.	.48	9LP1	9.95	1B42	5.80	RK-28	3.82	388A	2.95	851	47.00
1H4G	.89	6BC5	.88	7A7	.89	41	.79	10BP4	18.50	1B56	12.50	FG-32		WE-399A	6.70	860	32.50
1H8GT	.74	6BC7	1.10	7A8	.89	42	.99	10FP4	24.50	1B58	32.50	5588	6.75	417A	16.95	861	4.95
1H5GT	.99	6BD8GT	1.60	7AD7	1.44	42L7GT	1.29	12DP7	16.50	1B62	5.80	RK-34	.49	434A	17.50	864	26.50
1H6GT	1.10	6BD6	.99	7AH7	1.08	43	.99	12GP7	16.50	1B64	32.50	35T	6.95	446	1.95	865	.39
1J5G	1.19	6BE6	.72	7B4	.89	34	.99	12HP7	16.50	1H20	.88	35T Ion gauge	5.95	446A	1.95	865	1.20
1J6G	.99	6BF5	1.10	7B5	.89	35/51	.79	902P1	9.95	1K21	9.50	446B	2.25	446B	2.25	866A	1.48
1L4	.74	6BF6	.99	7B6	.89	35A5	.79	905	5.45	1Z2	15.75	35TG	4.95	450TH	42.50	869B	35.00
1LA4	1.10	6BG6G	1.92	7B7	.89	35B5	.99	Photo Cells		2B22	2.20	REL-36	.78	450TH	42.50	872A	3.95
1LA6	1.10	6BH6	.99	7B8	.89	35L6GT	.89	1P22	$4.10	2C21	.75	RK-47	4.92	451	1.39	874	1.45
1LB4	1.10	6BJ6	.99	7C4	.89	35W4	.85	1P24	1.27	2C22	.75	EF-50	.79	471A/		876	1.60
1LC5	.99	6BL7GT	1.45	7C5	.89	35Y4	.89	918	1.65	2C26	.69	VT-52	.65	1B21A	2.75	878	1.60
1LC6	1.10	6BN6	1.89	7C7	1.08	35Z4GT	.69	919	1.65	2C26A	.69	53A	5.40	885	3.80	885	3.80
1LD8	1.10	6BQ6GT	1.26	7E4A	1.20	35Z5GT	.89	923	1.35	2C34	.69	RK-59	2.44	50A5X	1.48	904	.99
1LE3	1.10	6C4	.65	7E6	.79	36	.69	927	1.45	2C39	22.00	RK-60	1.95	50A5X	1.47	905	.99
1LH4	1.10	6C5	.75	7E7	1.04	37	.69	931A	1.65	2C40	16.25	VT-62(Brl)	1.15	307AX	1.47	906	.99
1LN5	.91	6C8G	.89	7F7	1.09	38	.69	1613	1.95	2C42	26.50	RK-63	22.50	527	12.25	907	.99
1N5GT	.99	6C6	.88	7F8	1.20	39/44	.69	Thyratrons & Ignitrons		2C43	22.50	VT-67	.88	530	17.20	958A	.99
1N6G	.97	6C8G	1.35	7G7	1.32	41	.99			2C44	1.50	RK-69	2.25	531	4.20	959	1.50
1P5GT	.99	6CD6G	2.60	7H7	.99	42	.89			2C46	29.50	72	1.32	532A	3.95	991	.45
1Q5GT	.99	6CL6	.79	7J7	1.25	43	.89	OA4G	$1.32	2C51	5.75	73	1.32	WL-533	115.00	1003	.99
1R4	.69	6D8G	.99	7K7	1.32	45	.89	EL-C1A	4.75	2E22	1.85	VR-75/		559	2.20	1005	1.95
1R5	.89	6E5	1.10	7L7	1.32	45Z5GT	.79	2A4G	1.25	2E24	4.10	OA3	1.51	559	2.20	E-1148	.35
1S4	.89	6F5GT	.83	7N7	1.08	46	.99	2D4	2.10	2J21A	9.95	75T	5.80	HY615	.49	1201	1.20
1S5	.93	6F6	.99	7Q7	.99	47	.99	2C33	4.95	2J22	9.95	VR-78	.44	WL670A	8.70	1203	.69
1T4	.93	6F6G	.99	7R7	1.08	48	1.60	2D21	1.80	2J26	26.50	VR-90		700A	24.50	1291	.69
1T5GT	.99	6F7	1.05	7S7	1.32	49	1.19	3C22	9.95	2J27	24.50	(Brc)	115.00	700B	24.50	1294	.69
1U4	.93	6F8G	1.10	7V7	1.32	50	1.41	3C31 EL-C1B	3.95	2J31	39.50	OB3	1.29	700C	24.50	1299	.69
1U5	.81	6G6G	1.06	7W7	1.32	50A5	1.09	3C45	17.50	2J32	42.50	VT-98		700D	24.50	1613	2.25
1V	.88	6H6	.83	7Y4	.89	50B5	.88	4C35	17.50	2J33	39.50	(Brc)	115.00	702A	2.30	1614	2.30
1X2	1.00	6H6GT	.89	7Z4	.89	50C5	.88	EL-C5B	4C35	8.75	2J34	39.50	C1000E	2.30	702B	4.25	1616	2.00
2A3	1.28	6J5	.75	10	.45	50L6GT	.79	5C22	9.95	2J36	85.00	1000E	2.90	703A	6.95	1619	1.07
2A5	.79	6J5G	.84	12A	.79	50Y6GT	.92	5C22	83.45	2J37	13.70	1000TH	10.25	705A	2.75	1620	.99
2A7	.89	6J5GT	.84	12A6	.89	53	.95	C6J	9.95	2J38	17.50	WE-101D	1.85	705B	2.75	1621	6.25
2B7	.79	6J6	1.19	12A6GT	.79	55	.99	FG-17/5557	5.25	2J39	49.50	WE-101F	3.62	706AY	45.00	1622	2.30
2E5	.94	6J7	.99	12A7	1.16	BK55B	.40	FG-33	17.50	2J40	39.50	WE-102F	2.85	706BY	45.00	1623	2.30
2X2	.99	6J7GT	.99	12A8GT	.89	L55B	.52	FG-41	122.50	2J41	175.00	VR-105/		706CY	45.00	1625	.45
2X2A	1.85	6J8G	1.28	12AH7GT	1.32	56	.69	FG-47	14.50	2J48	27.50	OC3	1.20	706FY	45.00	1626	.39
3A4	.65	6K5GT	.99	12AL5	.89	57	.89	FG-81A	4.95	2J49	65.00	WE-113A	1.32	706GY	45.00	1629	.39
3A5	1.89	6K6GT	.69	12AT6	.59	58	.89	91	7.85	2J50	39.50	HY-114	.95	706HY	45.00	1630	.95
3A8GT	1.25	6K7	.88	12AT7	1.15	59	.99	FG-95		2J3051	7.50	WE-117A	.95	707A	9.95	1631	1.30
3B7	.69	6K7G	.88	12AU6	.79	70L7GT	1.52	5560	25.00	2J55	87.50	F-123A	8.95	707B	22.50	1636	3.10
3C6	1.15	6K8	1.22	12AU7	.95	71A	.79	FG-104		2J56	150.00	WE-126A	3.80	708A	4.85	1638	.70
3D6	.69	6K8GT	.96	12AV6	.63	75	.89	5561	24.60	2J61	45.20	F-127A	22.50	708B	4.85	1640	1.95
3LF4	1.10	6L5G	1.06	12AW6	1.20	76	.69	FG-105	19.50	2K23	37.50	VT-127A	3.60	710A	1.70	1641	1.95
3Q4	.93	6L6	2.13	12AX7	1.08	77	.69	FG-166	95.00	2K25	33.50	AB-150	12.50	713A	1.45	1642	.75
3Q5GT	1.10	6L6G	1.99	12BA6	.72	78	.79	FG-172	95.00	2K26	107.15	VR-150/		715A	6.75	1643	1.17
3S4	.93	6L6GA	1.75	12BA7	.95	79	.89	FG-176	14.50	2K28	34.50	OD3	1.15	715B	12.75	1644	1.95
3V4	.93	6L7	1.08	12BD6	.99	80	.65	RX-233A	4.95	2K29	26.00	FG-190	12.15	715C	26.50	1648	1.95
5A24	.69	6L7G	.95	12BE6	.70	81	1.41	FG-235A		2K33	295.00	HF-200	10.50	717C	26.50	1649	135.00
5T4	2.29	6L7GT	1.08	12C8	.89	82	1.19	5852	94.50	2K45	145.00	7-40	7.40	717A	1.47	1654	5.35
5U4G	.69	6N7GT	1.20	12F5GT	.79	83	1.59	FG-271		2K54	135.00	203B	6.33	718AY	45.00	1691	7.75
5V4G	1.20	6P5GT	.94	12H6	.69	83V	1.45	5551	62.50	2K55	135.00	204A	49.50	718BY	45.00	1692	7.75
5W4	.82	6Q7	.69	12J5GT	.69	84 6Z4	.79	5553	8.50	2X2A	1.85	CE-206	19.50	719A	45.00	3693	26.50
5X4G	.87	6Q7G	.89	12K8	.99	85	.79	394A	4.77	3B22		211	.95	720CY	75.00	UX-6053	.65
5Y3GT	.59	6R7	.99	12Q7GT	.89	89Y	.55	GL-415		EL-1C	2.95	WE-211D	12.50	720DY	75.00	7193	.75
5Y4G	.77	6S7	.99	12SA7	.89	1171.7GT	1.89	5558	39.50	3B23	8.75	WE-211E	12.50	721A	4.50	8005	5.95
5Z3	.87	6S7	1.06	12SA7GT	.89	1172P7GT	1.89	KU-610	12.50	3B24	9.25	212E	42.50	723A	9.95	8011	.87
5Z4	1.20	6S7G	.99	12SF5	.79	1172Z3	.74	KU-623	39.50	3B24W	7.95	WE-215A	.24	723A/B	18.50	8012	2.60
6A4	1.35	6SA7	.99	12SF5GT	.79	1172Z6GT	.97	KU-628	22.25	3B25	4.50	217C	8.95	724A	3.22	8013A	2.75
6A6	1.17	6SA7GT	.99	12SF7	.79	FM-1000	1.50	KU-634	39.50	3B26	5.75	221A	1.95	725A	3.22	8013A	4.90
6A7	1.05	6SB7Y	1.05	12SG7	.99	WL-652		5581	62.50	3B27	3.95	227A/		725A	8.95	8016	1.05
6A8	1.23	6SC7	1.20	12SH7	.89	5551	62.50	3C24	1.05	3C27	6.95	5C27	4.60	726A	8.50	8020	1.39
6AB4	.99	6SC7GT	1.05	12SJ7	.89	WL-654		3C27	6.95	WE-231D	2.25	726B	45.00	8020	6.95
6AB7	1.39	6SD7GT	1.10	12SJ7GT	.89	659	82.00	3D21	1.98	232CH	240.00	730A	25.00	9001	1.75
6AC5GT	1.35	6SF5	.83	12SK7	.81	2AP1	9.75	WL-672	22.00	3D21A	2.25	WE-244A	5.20	731A	2.45	9002	1.50
6AC7	1.45	6SF5GT	1.03	12SL7GT	1.03	2AP1A	10.25	WL-677	39.50	3E29	14.50	WE-245A	2.35	WL-787	9.00	9003	1.75
6AC7W	3.25	6SF7	.99	12SN7GT	.99	3AP4	10.25	WL-681		3J31	95.00	WE-249B	3.50	788Y	1.40	9004	.88
6AD4G	.98	6SG7	.91	12SQ7GT	.79	3BP1	7.95	5550	39.50	4-125A	29.50	WE-249C	3.50	800	1.88	9005	1.95
6AD7G	1.39	6SH7	.89	12SR7	.89	3CP1	2.25	722A	3.75	4A/1	1.18	250TH	22.50	801A	.48	9006	.35
6AE6G	.89	6SH7GT	.99	12X3	1.19	3DP1	4.85	804	1.88	4B22/		275TL	22.50	802	6.95	9004	3.79
6AF6G	1.19	6SJ7	.89	12Z3	.89	3DP1A	6.75	805	1.98	EL-5B	8.95	WE-252A	5.65	803	8.95	189049	3.79
6AG5	1.19	6SJ7GT	.89	14A4	1.32	3EP1	4.95	1616	1.88	4B24	19.75	WE-294A	5.90	805	4.80	199698	2.69

SYNCHROS

ARMY ORDNANCE, NAVY ORDNANCE AND COMMERCIAL SIZE 1, 3, 5, 6, 7 and 8 GENERATORS, MOTORS, CONTROL TRANSFORMERS, DIFFERENTIAL GENERATORS AND DIFFERENTIAL MOTORS IN STOCK

AY-101D	1G	5F	7DG	N	C-44968-6	C-78249	C-78254
AY-120D	5B	5G	7G	X	C-56701	C-78410	C-78670
AY-130D	5CT	5N	A	2J1F1	C-69405-2	C-78411	
1CT	5D	6DG	B	2J1G1	C-69406-1	C-78415	
1F	5DG	6G	M	2J1H1	C-78248	C-79331	

SEND FOR COMPLETE LISTING

SYNCHRO CAPACITORS IN STOCK

Terms 20% cash with order, balance C. O. D. unless rated. All prices net F.O.B. our warehouse, Phila., Penna., subject to change without notice.

LECTRONIC RESEARCH LABORATORIES

715-19 ARCH ST. PHILA. 6, PA.

Telephones - MARKET 7-6771-2-3

Reliance Specials

TIMING MOTOR — 8 RPM 115V 60 cyc — E. Ingraham Co. **$1.95**

GEAR ASSORTMENT

100 small assorted gears. Most are stainless steel or brass. Experimenter's dream!.....Only $6.50

VERNIER DIAL or DRUM (From BC-221)

DIAL—3½" dia. 0-100 in 360°. Black with silver marks. Has thumblock. DRUM—0-50 in 180°. Black with silver marks .....either 85¢

SOUND POWER HANDSET — BRAND NEW

Includes 6 ft. cord.—No batteries or external power source used. $17.50 pr.

AC LINE CORDS—4 ft. long with molded rubber plug 10¢

Sound Powered Chest Set RCA—With 24 Ft. Cord — Per Pair USED $17.60 NEW $26.40

400 CYCLE INVERTERS — Leeland Electric Co.

#10800 in: 30-28 V.D.C., 92 A. 8000 R.P.M. Out: 115V. 400 Cyc. 1 phase, 1500 V.A. 90 PF.....$24.95

3AG FUSES

Amp	Per 100	AMP	Per 100	AMP	Per 100
1/8	$4.00	3/4	$4.00	6	$3.00
3/8	4.00	4	3.00	10	3.00
1/2	4.00	5	3.00	15	3.00

DELAY NETWORK—ALL 1400Ω

T 114—Approx. 2.2 micro sec. delay..... } 95¢ each
T 115 Similar to T 114 with tap brought out.... }

BEARINGS

Mfg. No.	ID	OD	Thickness	Price
MRC3928-1	5 1/2	6 1/2"	1"	$3.50
MRC7926-1	5 5/64	6 15/64	9/16	3.50
Timken 37625	4 5/16	6 1/4	29/32	4.25
MRC-7021-200	4 1/8	5 9/32	23/64	2.95
Norma A 545	2 1/16	2 5/8	1/4"	1.00
MRC 106 M2	1 17/64	2 7/16	25/64	1.75
MRC 106 M1	1 13/64	2 7/16	25/64	1.60
Federal LS 11	1 1/8	2 1/2	5/8	1.75
Norma S 11 R	1 1/8	2 1/8	3/8	1.25
Fafnir B 541	1 1/16	1 1/2	9/32	.55
Hoover 7203	5/8	1 9/16	7/16	.90
Norma 203S	5/8	1 9/16	7/16	.90
SCHATZ	3/4	1 3/4	9/16	1.00
N5 5202-C13M	1/2	1 3/8	1 3/8	1.00
ND 3200	25/64	1 5/32	11/32	.35
Norma S 3R	3/8	7/8	7/32	.45
MRC 39 R1	11/32	1 1/32	5/16	.45
MRC 38 R3	5/16	55/64	9/32	.45

NEEDLE BEARINGS

TORRINGTON B108 ½" wide — ⅝" — 13'16" — 30¢

Brand New Meters—Guaranteed

0-10 ma. D.C. 3½"... 3.95 | 0-80 Amp. D.C. 2½"...$2.25
0-1 ma. D.C. 3½" Scale Reads 0-4 KV DeJur.....$5.75

SELENIUM RECTIFIERS

Full Wave 200 MA 115V.....$1.79
Half Wave 100 MA 115V......91

SPAGHETTI SLEEVING—assortment—99 feet.....$1.00

TYPE "J" POTENTIOMETERS

100	3/8	1,000	9/16	10K	5/8
100	S.S.*	1,500	1/4	15K	1/4
150	S.S.	2,000	1/4	15K	S.S.*
200	S.S.	2,000	S.S.*	25K	S.S.*
400	3/8	2,500	S.S.	50K	S.S.
400	S.S.*	3,000	3/8	70K	S.S.
500	S.S.*	4,000	3/8	80K	S.S.
1,000	3/8	5,000	1/4	100K	7/16

100K	S.S.*
200K	5/8
200K	S.S.*
250K	3/8
250K	S.S.*
500K	S.S.*
1Meg	3/8
1Meg	S.S.

* SPLIT LOCKING BUSHING.....$1.50 each

JONES BARRIER STRIPS

Type	Price	Type	Price	Type	Price
2-140Y	$0.13	5-141W	$0.36	3-142	$0.21
3-140¾W	.19	5-141	.26	2-150	.39
6-140	.25	5-141½W	.37	3-150	.54
10-140W	.53	7-141	.36		
10-140¼W	.53	6-141¾W	.49		
3-141¾W	.24	8-141½W	.58		
5-141W	.26	9-141Y	.64		

TIME DELAY RELAY — Eagle Signal Corp., Moline, Illinois

1 Min. Delay. 115 V., 60 Cycle
2½ second recycling time—spring return • Micro-switch contact, 10A • Holds ON as long as power is applied • Fully Cased •
ONLY $6.50

AN CONNECTORS
IMMEDIATE SERVICE
PHONE! WIRE! WRITE! YOUR NEEDS

NEW COAXIAL CABLES

	Price per 1,000 Ft.		Price per 1,000 Ft.
RG 5/U	$140.00	RG 22A/U	$385.00
RG 6	180.00	RG 24	675.00
RG 7*	85.00	RG 25	475.00
RG 8*	125.00	RG 29*	50.00
RG 9*	250.00	RG 34	300.00
RG 9A/U	275.00	RG 35	900.00
RG 10	240.00	RG 41*	295.00
RG 11*	135.00	RG 54A/U	97.00
RG 12	240.00	RG 55*	110.00
RG 13	216.00	RG 57*	325.00
RG 17	450.00	RG 58*	45.00
RG 18	900.00	RG 58A/U	80.00
RG 19	1250.00	RG 59*	70.00
RG 20	1450.00	RG 63*	75.00
RG 21	220.00	RG 77*	100.00
RG 22/U*	150.00		

Add 25% for orders less than 500 feet.
* No minimum order—others 250' minimum.

COAXIAL CABLE CONNECTORS

15¢ UG 175/U	$1.30 83-1F	30¢ 83-1AP	80¢ 83-1J	40¢ 83-1R	10¢ HOOD

83-1AC	$ .42	UG13/U	$1.75	UG 87/U	$1.60
83-1AP	.30	UG 21/U	1.20	UG 88/U	1.35
83-1F	1.30	UG 21B/U	1.55	UG 167/U	2.05
83-1H	.10	UG 22/U	1.30	UG 175/U	.15
83-1J	.80	UG 22A/U	1.65	UG 176/U	.15
83-1R	.40	UG 24/U	1.30	UG 206/U	1.40
83-1SP	.60	UG 25/U	1.25	UG 224/U	1.40
83-1SPN	.60	UG27/U	1.30	UG 255/U	2.45
83-1T	1.30	UG 30/U	2.50	UG 260/U	1.35
83-2AP	1.95	UG 57/U	2.20	UG 261/U	.77
83-2J	2.10	UG 58/U	.80	UG 290/U	1.35
83-22AP	1.10	UG 59A/U	2.25	UG 306/U	2.95
83-22SP	1.15	UG 60/U	2.40	UG 499/U	1.25
83-22R	.68	UG 85/U	1.75		
UG 255	2.45	UG 59A/U	2.25		
UG 224/U	1.40	UG 306	2.95		

DIFFERENTIAL — 115 V., 60 Cyc. #C78249 **$3.95 ea.**

3⅝" dia. x 5⅜" long
Used between two C78248's as a dampener. Can be converted to 3600 RPM Motor in 10 minutes. Conversion sheet supplied. (Converted).....$4.50
Mounting Brackets — Bakelite for selsyns, and differentials shown above.....35¢ pair

2J1G1 SELSYNS — 400 CYCLE—BRAND NEW

POSTAGE STAMP MICAS

mmf	mmf	mmf	mmf	mmf	mmf	mmf	mfd	mfd
7	23	47	82	180	500	800	.001625	.0053
7.5	24	51	90	220	510	820	.002	.0056
8	25	56	100	240	560	.001	.0027	.006
8.2	26	60	110	250	580	.0011	.003	.0062
10	30	62	120	350	600	.0012	.0033	.0065
15	33	68	125	370	620	.0013	.0035	.0068
18	39	70	150	390	650	.00126	.0036	.0082
20	40	75	160	400	680	.0015	.004	.01
22	43	80	175	470	750	.0016	.0044	

Price Schedule

8.2 mmf to 910 mmf.....5¢
.001 mmf. to .001625.....8¢
.002 mfd to .0082 mfd.....15¢
.01 mfd.....25¢

SILVER MICAS

mmf	mmf	mmf	mmf	mmf	mmf	mfd	mfd	mfd
8	47	82	155	275	485	800	.0022	.0033
10	50	100	170	325	470	875	.0023	.0039
18	51	110	180	350	500	.0011	.0024	.005
22	56	115	208	360	510	.0013	.0025	.0051
24	60	120	225	370	525	.0015	.0026	.0056
27	62	125	240	390	560	.0016	.0027	.006
30	66	130	250	400	570	.001625	.00282	.0068
39	68	135	260	410	580	.0018	.002826	.0082
40	75	150	270	430	700	.002	.003	.01

Price Schedule

10 mmf to 875 mfd.....10¢
.0011 mfd to .0023 mfd.....20¢
.0026 mfd to .0082 mfd.....50¢
.01 mfd.....$1.00

PULSE TANSFORMERS

UTAH—9262 9278 9280 9340
WESTERN ELECTRIC—D166173 D161310
KS8686, KS9365, KS9565, KS9800, KS9862, KS13161
GENERAL ELECTRIC—K2731 80-G-5
JEFFERSON ELECTRIC—C-12A-1318
DINION COIL—TR1048 TR1049
also 352-7250-2A; 352-7251-2A; T-1229621-60

PRECISION RESISTORS—¼ WATT—80¢

2	10.48	12.32	14.98	62.84	147.5	705
2.5	10.84	13.02	15.8	79.81	220.4	2,193
3.5	11.25	13.52	16.37	105.8	301.8	3,500
5	11.74	13.89		123.8	366.6	
6.68				125	414.3	50,149

PRECISION RESISTORS—½ WATT—35¢

.25	13.15	75	400	6,500	16,000	36,000
.334	13.3	87	723.1	7,000	16,700	37,000
.444	15	97.8	855	7,500	17,000	45,000
.502	18.75	125	970	7,500	19,860	47,000
.557	25	178	1,400	8,000	20,150	50,000
.627	45	179.5	2,500	8,500	21,300	56,000
.76	46	180	3,850	9,800	25,000	59,000
1.01	49	200	3,995	10,000	26,667	59,903
1.53	52	210	4,000	12,000	30,000	65,000
2.04	55.1	240	4,355	14,825	32,700	70,000
3.25	60	260	4,300	15,000	32,888	79,012
5.36	61	270	4,451	15,750	33,000	92,000
5.89	65	290	5,714	15,755	33,300	100,000
10.58	66.6	298.3	5,900	15,810	35,388	180,000
11.1	69	335				

PRECISION RESISTORS—1 WATT—45¢

.1	2.55	15	80	1,800	8,000	35,000
.11	2.58	15	125	2,200	8,250	56,000
.2	2.6	28	200	2,215	9,000	65,000
.31	2.66	30	270	2,250	10,000	68,000
.4	3.1	38	312	3,300	12,000	70,000
.861	3.99	45.5	420	5,000	12,420	84,000
1.01	4.29	54.25	425	5,221	12,500	90,000
1.166	5.51	60	1,830	7,000	50,000	95,000

PRECISION RESISTORS—1 WATT—60¢

100,000	166,100	220,000	399,000	590,000	
106,000	220,000	340,000	413,000	600,000	
120,000	240,000	348,000	520,000	646,000	
128,000	260,000	375,000	522,000	650,000	
130,000	270,000	376,000	550,000	700,000	
132,000	296,000	390,000	580,000	876,457	
149,800	310,000				
150,000					

MEGOHM 1 WATT 1%—$1.50—5%—60¢

PRECISION RESISTORS—2 WATT—75¢

4,385	5,000	6,000	10,000	19,917	23,000

UNIVERSAL JOINTS ALUMINUM
3/16" hole x ⅝ O.D. 1-½" long—**50¢**
¼" hole x ½ O.D. 1-½" long—**75¢**

OIL FILLED

MFD	V.D.C.	Price	MFD	V.D.C.	Price
.125	35,000	$35.95	4	1,500	$2.95
.125	27,000	28.95	3	1,000	1.95
.1	25,000	25.95	4	1,000	1.95
.25	20,000	19.95	2	1,000	.90
.15-.15	8,000	2.75	1.02	1,000	.65
.1	7,500	1.95	1	1,000	.45
.03	7,500	1.69	7	800	1.98
.1-.1	7,000	1.98	1	800	.55
.1	7,000	1.85	10	600	2.95
.02-.03	7,000	1.40	8-8	600	1.69
.1	6,000	2.75	8	600	2.95
.3-.03	6,000	1.35	7	600	1.75
2	4,000	4.95	4	600	1.63
.3x2	4,000	2.50	4 x 3	600	1.95
.1	4,000	2.25	2	600	.69
.05	4,000	1.45	2 x.5	600	.49
.1	3,500	1.95	8	500	1.55
.1	3,000	2.75	4	500	.98
.25	3,000	2.25			
8	2,000	4.95			
3	2,000	3.75			
.5-.1	2,000	1.95			
.5	2,000	1.95			
.3	2,000	1.75			
.1-.1	2,000	1.65			
.02	2,000	.79			
1	1,500	1.59			

2 mfd. 4,000 V.D.C. G.E. **$4.95**

OIL FILLED A.C. CONDENSERS

MFD	V.A.C.	Price	MFD	V.A.C.	Price
.2	750	$ .49	30	330	$4.50
8	660	4.95	25	330	5.95
6	660	4.95	20	330	5.50
5	660	4.50	15	330	4.50
4	660	4.25	10	330	3.95
2	660	2.25	6	330	2.95
1	660	2.45	4	330	1.95
15	440	4.95	3	330	1.25
6	440	3.50	10	220	2.95
5-3	440	3.95	20	220	4.95
4.4	375	2.15			

1N34 Crystal Diode.....79¢

300 Twin Lead.....02½ per ft. $18.95 per M.
Dynamotor DM 33A.....$3.75 ea.

Chokes: 30 Hy. 80MA @....$1.29; 6Hy. 80MA @..79¢

Power Tap Switch—OHMITE # 312—5 Tape non-shorting 25A 150 V. A.C.....$3.95

Timer—Industrial Timer Corp. 15 min. on 15 min. off continuous 115 V. A. C. Fully cased Plugs into octal socket.....$6.50

BC-224-D Receiver 12 V. D. C. 1.5 mc to 18 mc. Brand new. Includes tubes, dynamotor, shock mts...$125.00

Mike Connector Amphenol 80-81 Interchangeable with Amphenol 80-M cad plated.....25¢

Minimum Orders $5.....All orders f.o.b. PHILA, PA.

RELIANCE MERCHANDIZING CO.

Arch St. Cor. Croskey Phila. 3, Pa. *Telephone RIttenhouse 6-4927*

Buy TOP Radio-Electronic Values!

AIR TRIMMER CONDENSERS

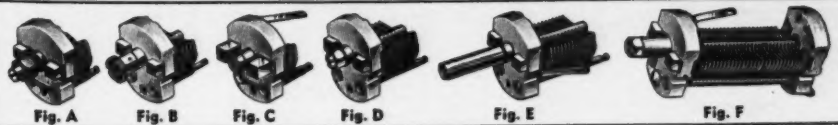


Fig. A | Fig. B | Fig. C | Fig. D | Fig. E | Fig. F

STOCK NO.	CAPACITY Min.	CAPACITY Max.	MANUFACTURER'S NUMBER	FIGURE	SHAFT LENGTH	POST LENGTH	GROUND LUG	PRICE EACH
2937	2.5	7	Hamm 250024	D	5/16	3/32	Right	19¢
5716*	3	8	ASP 17A324	A	9/16	3/32	Top	25¢
5717	3	10	ASP 22G192	A	9/16	3/32	To Post	18¢
4090	3	15	ASP 493213	E	1"x1/4" D	3/32	Left	25¢
2939	3	15	ASP 217-2	C	5/16	1/4	Top	20¢
5718	3	15	Tolrad 682070-30	D	5/16	3/32	Right	20¢
5719	3	15	Hamm 682070-30	D	5/16	3/32	Right	20¢
231	3	25	CAIM 481881	A	9/16	3/32	Left	25¢
5720	3	27	Hamm 11723-1	D	5/16	3/32	Right	25¢
5721	2.5	28	Comar M480864-6	D	5/16	3/32	Top	25¢
5723	3	29	ASP 22G190	A	9/16	3/32	To Post	25¢
2940	2	30	ASP A2H-501	D	5/16	3/16	To Post	30¢
5724	4.5	30	OB77S1E-25	D	5/16	5/16	Right	30¢
5086	3	30	Hamm SBL-72265-3	B	1/2	3/32	Bottom	20¢
2941	4.5	35	Hamm ESA682070-37	D	5/16	3/32	Left	30¢
233	5	54	Hamm ESA682070-35	D	5/16	3/32	Left	40¢
5087	5	54	Hamm BL 72265-4	B	1/2	3/32	Right	40¢
5725	4.5	55	Sickles M7466880-2	D	5/16	3/16	Right	40¢
5088	6	100	Hamm SBL72265-6	B	1/2	3/32	Bottom	50¢
5674	5	100	Hamm APCIE100	E	1 1/16"x1/4" D	3/32	Right	75¢
236**	8	140	ASP 19A14304	D	5/16	3/32	To Post	85¢
5675	6	150	Hamm APCIE150	E	1 1/16"x1/4" D	3/32	Right	75¢
5726	9	264	OAK 114M510	F	9/16	3/32	Top	95¢

* Double spaced plates.
** Adjusts both ends, some available w/dust cover.
Fig. A Round Shaft Screwdriver adj. w/locknut.
Fig. B Bakelite Knob Ins. Screwdriver adj.
Fig. C Round shaft Screwdriver adj.
Fig. D Hexnut Screwdriver adj.
Fig. E ¼ Round Shaft.
Fig. F Double End Plate.

INDUSTRIAL SOLDERING IRONS

Jewell 100 and 150 Watt heavy duty type. Underwriters approved. Polished chrome barrel. Nichrome heating element on stainless steel core. ⅜" copper tip. Standard cartons of 36 each.

Stock No.	Item	Price Each	Price Ea. Per Ctn.
5669	100W	$2.95	$2.50
5670	150W	3.25	2.75

TRANSMITTING MICAS

Stock No.	Cap.	Test Volts	Type No.	Price Each
5431A*	.01	1000	1445	.35¢
5434A	.02	1600	144T	.40¢
5435A	.006	1200	A 2	.40¢
5436A	.001	1500	BE 15	.25¢
5431A	.004	2500	G	.35¢
5439A	.001	5000	F	.50¢
5680A	.0036	5000	A2	$1.00
5681A	.15	1000V	X5	1.90
5682A	.00007	2500V	9	.50¢
5683A	.00005	3000V	15L	1.90
5684A	.0001	5000V	P2L	1.90
5685A	.0006	5000V	P21	1.90
5686A	.000025	10,000	PL-34L	1.95
5687A**	.00015	10,000	PL-315	7.95

* Supplied with Motor Bracket
** D.C. Working Voltage
OTHER TYPES AND SIZES AVAILABLE

STRAP ST-19-A

59" long x 2" wide heavy olive drab webbing includes: 3 snap hooks with slide.

Price ..... $1.00 ea.

WRITE FOR COMPLETE BULLETIN

OUR FULLY ILLUSTRATED BULLETIN OF ELECTRONIC PARTS IS MAILED AT REGULAR INTERVALS TO MANUFACTURERS AND WHOLESALERS. IN THE CATALOG ARE LISTED AND PICTURED HUNDREDS OF ITEMS OF INTEREST TO PURCHASING AGENTS OF ELECTRONIC PARTS. WE SHALL BE PLEASED TO PLACE YOUR COMPANY'S NAME ON OUR MAILING LIST. PLEASE REQUEST ON YOUR COMPANY LETTERHEAD.

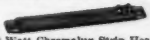
10" PM SPEAKERS

Permoflux 10" PM Speaker with 2.15 oz. Magnet. Packed 18 to a carton.

Stock No. 5335 — Price Each **$3.35**

Carton Lot $52.00

STRIP HEATERS



24 Volt—150 Watt Chromalux Strip Heaters. Manufactured by E. L. Wiegand Co., 1½" x 12" x ⅝" thick.

Stock No. 5482 A — Price Each **95¢**

Standard Brand. MFR. Name on Request

OIL FILLED CONDENSERS

Stock No.	Capacity & Voltage	Lug Arrangement	Type No.	Price Each
5166A	.01-600V	Side	306-91	15¢
254A	.05-600V	Top	XDMRTWG	18¢
5167A	.1-600V	Side	306-357	20¢
544A	2 x .1-600V	Side	DYR 6111	25¢
2908A	2 x .09-600V	Top	DYR 600 23	18¢
2911	2 x .1-600V	Top	DYR 6011	22¢
5172*	2 x .1-600V	Top	306-361	25¢

* Can is common ground—Other types and sizes available

Standard Brand. MFR. Name on Request

ECLIPSE VOLTAGE REGULATOR

5603A Bendix Eclipse V.R. 1365 Model 2 Style A — volts set at 115

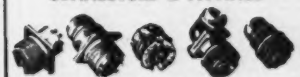
Stock No. 5608A — $2.95 ea.

THORDARSON AUDIO PASS FILTERS

Band pass 300 to 1200 cycles input 10000 ohms—Output 25000 ohms Level 10DB

Stock No. T48500 Price to: $5.50 ea.

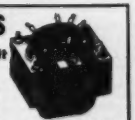
AMPHENOL & CANNON CONNECTORS & FITTINGS



WRITE YOUR REQUIREMENTS

We can Possibly furnish about 75% of complete Amphenol & Cannon list.

6.3 VOLT FILAMENT TRANSFORMERS



Primary 115 Volt 60 Cycle 1600 Insulation Three 6.3 Volt Secondaries

6.3 Volts @ 4.9 Amps.
6.3 Volts @ 4.8 Amps.
6.3 Volts @ 1.1 Amps.

Horizontal Half Shell Mounting. 3¼" x 2 13/16" Mounting Centers. 2 13/16" x 3⅛" Core Size. 2⅛" above Chassis. Solder Lug Terminals—All Terminals Marked.

Stock No. 5234 A — Price Each **$2.65**

Terms: Open Account to rated or acceptable reference accounts. Others Pre-payment or 25% deposit with order, balance C.O.D. Price F.O.B. Chicago and subject to change without notice. Merchandise subject to prior sale.

Radio Surplus Corp.

732 South Sherman Street
Chicago 5, Illinois
Phone: HArrison 7-5923

MOTOR GENERATORS

2.5 KVA Diehl Elec. Co. 120 V.D.C. to 120V A.C. 60 cy. 1Ph., 41FF. Complete with Magnetic Controller, 2 Field Rheos and Full Set of Spare Parts including Spare Armatures for Generator and Motor. Full spec. on request. New.....$285.00

2 KVA O'Keefe and Merritt. 115V DC to 120V AC, 50 cy. Idles at 3 Ph. syncs motor on 208V, 50 cy. New. Export crated.....$165.00

1.25 KVA Allis-Chalmers. 230 DC to 120 AC, 80 cy. 1 Ph. Fully enclosed. Splashproof, Ball Bearings, centrifugal starter. New, complete with kit of Spare parts.....$175.00

M.G. 164, Hettzer-Cabot Motor: 440V, 3Ph, 60 cy., .90A. 1/3 HP, 1750 RPM. Generator: 70V, 3Ph, 146 Cy., .140KVA. Exciter: 115DC, 1A. New...$67.50

INVERTERS

Onan MG-215H. Navy type PU/13. Input 115/230, 60 cy, 1 Ph. Output 115, 480 c. 1 Ph. 1200W and 26V DC at 4 amps. New.....$295.00

G.E. Model 5D-21NJ3A. Input: 24V, DC. Output: 115V, 400 cy., 485 Va. New.....$29.50

Leland Elec. Co. Model PE206A. Input: 28V, DC. 38 Amps. Output, 80V., 800 cy, 485 VA. New $22.50

G.E. J8169172. Input: 28V, DC, Output: 115, 400 cycles at 1.5 KVA. New.....$32.50

DYNAMOTORS

Navy-Type CAJO-2114A4. 105/130V DC to 13V DC at 40A or 26V DC at 20A. Radio Filtered. Complete with Line Switch. New.....$69.50

Elecor. 32V DC to 110V AC, 60 cy, 1 Ph, 2.4 Amps. New.....$32.50

Type PE94CM. For use with SCR522 Transmitter-Receiver. Brand new in export cases.....$19.50

Carter 6V DC to 400V DC at 375 mils. New $39.50

AMPLIDYNES

G. E. Model 5AM21J17. 4000 R.P.M. Motor Compound wound. 150 Watts. Input: 27V DC. Output: 60V DC, Big Corpe. U. S. Army MG-27-B. New.....$34.50

Edison type 5AM3INJ18A. Input: 27 volts, 44 Amps., 8300 RPM. Output: 60V DC at 8.8 amps, 530 Watts. New.....$22.50

G.E. Model 5AM45D820. Input: 115V, 60 cy, 1 Ph, 3450 RPM. Output: 250VDC 0.5 Amps.

Price $165.00

SMALL D.C. MOTORS

G.E. Model 5BA50L12A. Armature 27V D.C. at 8.3A Field 60V DC at 2.3A. RPM 4000. H.P. 0.5 New.....$27.50

Electrolux Corp. of Canada. P/O vent fan assembly for SCR-602-T6. 1/35HP, 28.5V, 2.15 amps. 2200 RPM. Price.....$16.50

Oster type E-7-5, 27.5V, 1/20HP, 3650 RPM. Shunt wound. Price.....$15.00

Dumore Co. Type EBLG, 24V DC, 40-1 gear ratio for use with type B-4 Intervalometer. Price $17.50

400 CY. BLOWERS

Westinghouse 115V, 400 cy. 17 c.f.m. Includes capacitor. Price.....$12.50

SYNCHROS

Ford Inst. Co. Type 58DG. Brand New.....$22.50

Electrolux Torque Motor.....$16.50

SOUND POWERED PHONES

Western Electric No. D173312, Type O. Combination headset and chest microphone. Brand new including 20 ft. of rubber covered cable.....$17.50

Automatic Electric Co. No. GL843A0. Similar to above but including Throat microphone in addition to chest microphone. Brand new with 20 ft. rubber covered cable.....$16.00

U. S. Instrument Co. No. A-260. Complete with 20' cable and plug. Brand new.....$17.50

W. E. type TS-10M Handset. New.....$16.50

W.E. Type 3108 Laboratory Headsets. Price per set.....$8.50

RELAYS

Struthers-Dunn 1HXX129, 110 D.C.....$2.68

Advance type 455C, SPDT, 115 A.C.....$1.95

Leach type 1154A, SPDT, 115 A.C.....$2.35

Leach type 1054, BSN 20-28V D.C.....$2.35

Clare Plug-in base No. 30FMX 115 A.C.....$3.50

G.E. Plug-in base Sensitive K27J853......$4.50

Allied Control type BJ 453-1128......$1.95

Western Electric D-163781 Plug-in......$10.00

Guardian Time Delay type B-9-SPDT......$2.95

Haydon Time Delay 17717 110V/60......$4.75

AN/APA 10 PANORAMIC ADAPTER

SENSITIVITY: "A" channel, 400 microvolts or less per ¼" beam deflection. "B" channel, 400 microvolts or less per ¼" beam deflection. "C" channel, 1 volt or less per ¼" beam deflection.

RESOLUTION: 12 kilocycles at 3 db down from peak, sweep control at maximum, using CW signal.

PRESENTATION: Panoramic ("A" & "B" channels): Oscillographic, "C" channel.

SWEEP WIDTH: Channel A: ± 50 kc (100 kc overall) Channel B, ± 500 kc (1 Mc overall) Channel C, ± 1 Mc (2 Mc overall).

CATHODE RAY SWEEP: Oscillatory or non-oscillatory (Servo) Variable Sawtooth Generator, 35 to 40,000 cycles per second.

AUDIO OUTPUT: 50 milliwatts into 600 or 8000 ohm load.

VERTICAL AMPLIFIER: Single stage, ± 2db from 30 cycles to 100 kc or higher. Amplifier out position permits direct connection to one vertical plate through coupling capacitor.

HORIZONTAL AMPLIFIER: Single stage, ± 2db from 30 cycles to 100 kc. No provision for direct connection to deflection plates.

CATHODE RAY TUBE VOLTAGE: Cathode to accelerating anode; 1200V DC for 115V A.C. input.

SENSITIVITY OF CATHODE RAY OSCILLOSCOPE: Maximum through Amplifier. Horisontal: 10 volts peak to peak per inch. Vertical: 1.5 volts peak to peak per inch.

DIRECT TO VERTICAL PLATE: 150 volts peak to peak per inch.

NOISE: No disturbance in excess of 25,000 microvolts between 200kc to 200Mc generated by equipment.

Overall Dimensions: 19-9/16" x 10¼" x 7¾".

Weight: 40 lbs.

Power Requirements: 115V, A.C. 60 cycles, 1 phase. With 21 tubes including 3" scope tube, for operation on 115 V. 60 cycle source. **PRICE**.....$245.00

Gov't Cost $1800.00.

AN/APA-10 80 Page Tech Manual.....$2.75

TEST EQUIPMENT

TS-127/U Lavoie Freq. Meter—275 to 725 MC.
TS-47APR Test Osc. 40-500MC.
TS-487/U Peak to Peak VTVM.
AN/APR-1 Receiving sets.
R111A/APR-5A Receiver—1000 to 6000 MC.
AN/APR-4 Tunning Units TN-17 (76-300 MC).
AN/APR-4 Tuning Units TN-18 (300-1000 MC).
AN/APR-4 Tuning Units TN-19 (850-2200 MC).
TU-58 Range "A" Tuning Units (110-370 MC).
BC1203 APN-4 Tests Sets.
AN/APA-10 Panoramic Adaptors 115V/60 cycles.

Repair Parts for BC-348 (H, K, L, R only)
Also BC 224 Models F, K. Coils for ant., r.f., det., osc., I.F., c.w. osc., xtal filters, 4 gang cond., front panels, dial assemblies, vol. conts., etc. Write for complete list and free diagram.

HIGH QUALITY CRYSTAL UNITS
Western Electric—type CR-1A/AR in holders. ½" pin spacing. Ideal for net frequency operation. Available in guaranteed 5910-6350-6370-6470-6510-6610-6670-6690-6940-7270-7350-7380-7390-7460-7580-9720. All fundamentals in KC. Good multipliers to higher frequencies.....$1.25 each

RADAR

Antenna-Trans-Rec Unit ASG-1.
Radar Set SQ complete with spares.
Modulator type SO-11.
Pulse Timers CUZ-50AGD (SD-5 Radar)
Radar Crystal Units 96.35Kc, Raytheon.
1N21B Sylvania Diodes.
Repeater Adapters CRM-50 AFO.
SO Series Accessory Control Panels.
SO Series Transmitter-Receiver unit.
CARD 23AEK Bearing Control Units for SO Series.
Auxiliary Rectifier.
SG Rectifier Power Units CRP-20ABN.
SG Rectifier Power Unit CRP-20ABM.
SG Modulation Generators CRP-35AAH.
SG Radar Receivers CRP-46ABD-1.
SG Complete trans. RF Coupling Assemblies.
SG Power Control Chassis.
SG Driver Modulator Assemblies.
SG Complete sets equipment spares.
SG Load Divider Modernisation kits.

SONAR EQUIPMENT

Hoist Train Mechanisms, Navy type 78219, for Model QBG, Underwater Sound equipment. Purpose: To lower or raise projector. Travel 3'9". Includes 1 partial set of spare parts. 1 wooden box per set; Weight and cube per box: 437 lbs., 42.0 cu.

RECTIFIERS

G.E. No. 6 RC89F16 for 54 cells 10 amps.
G.E. No. 6 RC133F2—In: 110/230/60/1. Out: 15/30V-75-150A
Mallory APS-20—In: 115/230/60/3. Out: 13/24V-65-130A
Turret Trainer Supply. In: 230/60/3. Out: 28V-130A
Complete specs on request

TERMS: Rated Concerns Net 30, FOB Bronxville, New York. All Merchandise Guaranteed. Prices Subject to Change

400 CYCLE TRANSFORMERS

AUTO. 400 cy. G.E. Cat. No. 86G184.

KVA .9458-.520P Volts 460/345/200/115. New $6.95

FILAMENT. 400/2800 cy. Input: 0/75/80/85/105/115/125V. Output: 5V3A/5V3A/5V3A/5V3A/5V6A/5V6A/6.3V6A/6.3A. New.....$2.95

PLATE & FIL. Raytheon UX725A. Pri: 115. Sec #1: 630VCT/0.065A. Sec #2: 5V/3A. Sec #3: 640VCT/0.10A. Sec #4: 5V/3A. T.V. 1780 RMS.....$4.75

PLATE WECO KS9560, 400/800 cy. Pri: 115V. Sec: 1350-0-1350 at .057A (2700 V Total). Electat shlded. Wt. 2.3 lbs. New.....$2.95

Plate. Thordarson #T46B29. 1650 VA. Pri: 105-120V. 500 cy. 1 PH. Sec: 2600V. Center tapped. 1.5KV insulation. Brand new.....$40.50

PLATE & FIL. WECO KS9555, 400 cy. Pri: 115V. Sec #1: 930-0-930. Sec #2: Three 6.3V windings.....$4.95

FILAMENT. 400/2400 cps. WECO KS9553. Pri: 115V. Sec: 8.2V1.35A/6.35V1.5A Electat shlded. Wt. 0.5 lbs. New.....$2.95

PLATE & FIL. 400/2600 cy. Pri: 0/80/115V. Sec: #1=1200VDC at 1.5MA. Sec #2=400VDC at 130MA. Fil. Sec: 6.4V4.5A/6.35V0.8A (lbs. 1500V)/5V2A/5V2A.....$4.95

RETARD. 400 cy. WECO KS9698. 4 Henry 100MA.....$2.75

HIGH POT TRANSFORMERS

High Voltage Trans. Westinghouse Pri: 115, 60 cy. Sec: 15,000 C.T., 60 MA. Good for Hi-Pot test set up. C. T. ungrounded.....$39.50

PULSE TRANSFORMERS

PULSE. WECO KS-9563. Supplies voltage peaks of 3500 from 807 tube. Tested at 2000 Pulses/sec and 5000V peak. Wdg. 1-2=18 ohms. Wdg. 1-3=72 ohms. L of Wdg. 1-3 =.083H at 100 cps.....$7.50

PULSE. WECO KS-161310, 50 KC to 4MC. 1⅝" Dia. x 1⅝" high, 120 to 2350 ohms. New.....$8.75

High Reactance Trans. G.E. type Y-3502A. 60 cy. Voltage 11200-135. Inductance H.V. Winding 135 Henries. Output: Peak Voltage 22.5KV. Cat. 8318065G1. New.....$69.50

400 CY. SERVO TRANSFORMERS

G.E. #8SG665X Pri: 57.5V. Sec: #1=28.75V. Sec: #2=28.75V.....$3.75

G.E. #8SG666X Pri: 57.5V. Sec: 115V C.T. $3.75

G.E. #8SG667 Pri: 230V C.T. Sec: 230 V C.T. $3.75

G.E. #8SG668X Pri: 115V. Sec: 275V/275V/275V/275V/230V/230V/6.3V CT/6.3V CT.....$8.50

RAYTHEON VOLTAGE REGULATORS

Adj. input taps 95-130V., 60 cy. 1 Ph. Output: 115V, 40 Watts, ¼ of 1% Reg. Wt. 20 lbs. 6¼" H x 8¾" L x 4¾" W. Overload protected. Sturdily constructed. Tropicalized. Special.....$16.75

AMPLIFIERS

GE Servo type 2CV1C1 400 cycle
Constant Output Line BC-730C
Synchro amplifiers for Radar
Intercommunication type BC-605

ANTENNAS

Coast Guard MB-162 Whips 23½ ft.
Microwave types AT-49, AT-38, AS-125
APT-3 Dipole Antennas
TDY Radar Jammer Horns
Paraboloids, Magnesium Dishes 17⅛" dia.
SCR-634-A (Part of RC-155-B Antenna).
APT-3 Dipole Antenna

POTENTIOMETERS

W.E. KS-15138 Linear Sawtooth
W.E. KS-8732 for SCR547 Radar
W.E. KS-8801 Motor Driven

MISCELLANEOUS

Cathode Ray Shields for 3" tube.....$3.75
Variac type Motor Controls 600 watt.....$13.50
10 CM Waveguide 90° elbow.....$20.00
Adel Clamps assorted types—write for samples
Shock Mounts Lord 320.....$.40
Shock Mounts U. S. Rubber #5150C.....$.30
Commando Pole Jacks (Cook Elec. Co).....$1.00
Fusetron (Bus FRN 50 Ampere 250V).....$.25
Switchboard Lamp Receptacles & Jewels.....$.40
SCR522 Transmitter Receivers Brand New
TCS Transmitters 125 watt Ship to Shore
BC966A Transponders
RT7-AN/APN-1 Receivers
BC-423B Modulators
BC-1366M Jack Boxes—Large quantity
Sweep Generator Capacitors 5/10 mfd.

VIBRATORS

12 Volt Synchronous. Fed. Tel. & Radio Corp. For TA-3/ft Ringers. Quantity available. Brand new. $1.25

HI-VOLT CAPACITORS

.25 Mfd., 20KV.....$26.50
.25 Mfd., 15KV.....$22.50
1 Mfd., 15KV.....$44.50
1 Mfd., 7.5KV.....$12.50
2 Mfd., 6.0KVA.....$14.50

ELECTRONICRAFT
INC.
27 MILBURN ST. BRONXVILLE 8, N. Y.
PHONE BRONXVILLE 2-0044

INDICATORS

ID-24/ARN-9.....$12.50
ID-14/APN-1.....$7.95
I-82A.....$9.75
ID-60/APA-10 Panoramic Adapter converted for 60 cycle operation—complete with tubes and 80 page Tech. Manual.....$245.00

RELAYS

This list represents only a small part of more than a million relays in our stock—one of the world's largest. All relays are standard, brand new in original packing, and fully guaranteed by Relay Sales.
Send us your relay requirements. If the items are in stock we can make immediate delivery at substantial savings in cost to you.

SHORT TELEPHONE RELAYS

STK. NO.	VOLTAGE	OHMAGE	CONTACTS	UNIT PRICE
R-635	12 VDC	100	1C&1B	$1.35
R-308	12 VDC	100	2C @ 4 Amps	1.85
R-343	12 VDC	100	1C	2.00
R-826	12 VDC	150	2C, 1B	1.55
R-770	24 VDC	150	1A/10 Amps	1.45
R-368	8/12 VDC	200	1B	1.40
R-771	24 VDC	200	1A/10 Amps	1.45
R-603	18/24 VDC	400	2A	1.55
R-575	24 VDC	500	2C	2.40
R-764	48 VDC	1000	1C&2A	2.00
R-417	5.5 ma	5800	2C	2.50
R-563	60/120 VDC	7500	1A	2/3.10
R-213	5/8 VAC 60 Cy.	....	2A	2.50
R-801	115 VAC	....	NONE	1.45
R-589	12 VDC	125	2A	1.30
R-113	12 VDC	150	4A	1.55
R-689	12/24 VDC	255	1C	1.55
R-799	24 VDC	500	NONE	1.00
R-115	24 VDC	500	1C	1.70
R-110	24/32 VDC	3500	1C	2/3.45
R-121	150 VDC	5000	2A&1C	2.05
R-122	150 VDC	5000	2C/Octal Base	2.50
R-634	150/250 VDC	6000	1A&1B	2.45
R-369	8/12 VDC	150	2A, 2B	1.60
R-908	6 VDC	15	4A @ 4 Amps	1.50
R-800	12 VDC	150	2C&1A	1.55
R-537	12/24 VDC	150	2C&1B	2.00
R-750	24 VDC	400	1A	1.60
R-367	10/16 VDC	195	2C	2.50
R-335	20/30 VDC	700	2A, 1C	2.00
R-366	30/120 VDC	4850	1C	2.50

STANDARD TELEPHONE RELAYS

STK. NO.	VOLTAGE	OHMAGE	CONTACTS	UNIT PRICE
R-806	115 VAC	900	1A	$2.05
R-161	6 VDC	10	2B&1A	1.10
R-873	6 VDC	12	3C-3A MICALEX	3.00
R-305	12 VDC	50	2A Split Cerm.	1.35
R-360	24 VDC	200	1C	1.50
R-484	24 VDC	200	2A, 1C	1.35
R-337	24/48 VDC	1200	1A, 2B Split	2.65
R-101	24 VDC	1300	2A	2.50
R-868	30/162 VDC	3300	1C	1.90
R-365	52/162 VDC	3300	4C	3.95
R-518	85/125 VDC	6500	1C	3.60
R-918	52/228 VDC	6500	1C	3.60
R-852	52/228 VDC	6500	1C, 1A	3.00
R-341	75/228 VDC	6500	4C @ 4 Amps	3.65
R-633	180/350 VDC	10,000	1C @ 5 Amps	2.90
R-344	72/300 VDC	11,300	3A, 1B	2.45
R-332	100/350 VDC	40,000	2A	3.50
R-664	110 VAC	....	2B&1A/OCT.SOCKET	2.45
R-667	6 VDC	.75	1B/10AMP. 1A/3AMP.	1.45
R-632	6 VDC	12	5A&1C	3.25
R-154	6/12 VDC	200	1A	1.50
R-517	12 VDC	250	2A	1.50
R-116	85 VDC	3000	1B	3.05
R-631	100/125 VDC	3300	2A	1.90
R-545	110/250 VDC	7000	1C	2.40
R-124	300 VDC	12,000	1A	1.55
R-511	24 VDC	200	W/MICRO N.O.	3.05
R-160	6 VDC	12	3C&3A	3.00
R-851	52/228 VDC	6500	1C, 1A	3.00
R-591	6 VDC	40	1B&1C	1.35
R-155	12 VDC	100	1A&1B	1.45
R-520	200/300 VDC	14,000	2C	3.45
R-159	6 VDC	50	2A	1.35
R-158	6 VDC	50	4A Cerm.	1.85
R-381	6/8 VDC	100	1A Split	2.50
R-382	6/12 VDC	200	1B Split	2.50
R-153	12 VDC	200	1C&1A	1.55
R-304	12 VDC	200	4A Split Cerm.	2.50
R-383	6/12 VDC	500	1A Split	2.50
R-385	6/12 VDC	500	1B Split	2.50
R-384	6/12 VDC	500	3A Split	3.00
R-576	12 VDC	200	2A	2.50
R-316	24 VDC	200	1C	1.50

OTHER RELAY TYPES IN STOCK

- Keying Relays
- Rotary Relays
- Contactors
- Midget Relays
- Voltage Regulators
- Differential Relays
- Sealed Relays
- Special Relays

WRITE FOR CONTACT DATA

Manufacturers and Distributors:
Write for the new Relay Sales Catalog.

Telephone
SEeley 8-4146

Relay Sales

833 W. CHICAGO AVE., DEPT. 2, CHICAGO 22, ILL.

SEE OUR PREVIOUS ELECTRONICS ADS FOR LISTINGS OR WRITE FOR CIRCULARS

Over 300,000 RELAYS in our Vast Stock

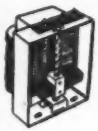
WE ALSO HAVE PRODUCTION QUANTITIES IN STOCK OF:

APC AIR TRIMMERS
BINDING POSTS
CABLE
CAPACITORS
CERAMICONS
CERAMICS
ADEL & TINNERMAN CLAMPS
CHOKES
COILS
CONTROLS
CRYSTALS
FILTERS
FUSES
KOVAR GLASS SEALS
RUBBER GROMMETS
HARDWARE
IRON CORE SLUGS
KNOBS
SINE-COSINE POTENTIOMETERS
PULSE TRANSFORMERS
RELAYS
RESISTORS
SERVO TRANSFORMERS
SHOCKMOUNTS
SOCKETS
SPAGHETTI
MICRO SWITCHES
TOGGLE SWITCHES
TRANSFORMERS
TUBES
AND OTHER RADIO & ELECTRONIC PARTS

110V 60 Cyc TIMING MOTORS

INGRAHAM 8 RPM Fully Enclosed..$1.95
TELECHRON 3.6 RPM..... 2.50
GILBERT With Gear Train for 6 RPDay 1.95
GILBERT 60 RPM (1 RPS)..... 1.75

VOLTAGE REGULATOR



Amertran Transtat
90 to 130 V, 50-60 cyc, 17.5 Amps, #T282..$17.50
103 to 126 V, 50-60 cyc, 2.17 Amps, #T283...$9.95
W. E. D122855, 92 to 115 V, 400 cyc, 5.5 Amps, #T28 $6.75—10 for $60.00

SHOCKMOUNTS

Series	Mfg	Lb	Ea	Series	Mfg.	Lb	Ea
100	Lord	1	.10	200	Lord	7	.30
100	Lord	2	.10	200	Lord	45	.45
100	Lord	4	.12	200PH	Lord	6	.35
100	Lord	8	.15	200PH	Lord	10	.35
100	Lord	9	.18	200PH	Lord	12	.38
180	Lord	8	.20	250PH	Lord	15	.40
180	Lord	10	.20	250PH	Lord	45	.40
180	G'year	25	.28	**OTHER MOUNTS**			
180PH	Lord	4	.25				
180PH	Lord	6	.25	VX1021 Harris 2 oz.			.10
200	Lord	10	.28	2/4" Dia. Lord 2 Lb.			.10
200	Lord	20	.30	279 Series 250 Lord			1.00
200	Lord	25	.38	C3030 Barry			1.00

MICROSWITCHES

10 Amp 125 V

Type	Action	Actuator	Each
YZ3R5	SPST n.c.	Pin	.59
BZ2R5	SPDT	Pin	.69
V313	SPST n.o.	Wire	.69
WZ3RTC,	SPST n.c.	Pin	.59
APR201	SPST n.o.	Plunger	.79
WZR21	SPST n.c.	Plunger	.79
WZE7RQNT	SPST n.c. Enclosed	Plunger type	1.50
WZ3RD1	SPST n.c.	Button	.69
WZ7RST1	SPST n.c.	Plunger	.79
YZR31	SPST n.o.	Pin	.69
YZ7RTC	SPST n.o.	Pin	.69
BZR5	SPDT	Pin	.79

ACRO SWITCHES

2MC31A	SPSTn.c.	Pin	.59
2MD21A	SPDT 6A	Pin	.69
2MD31A	SPDT	Pin	.79
XC721	SPST n.c.	Leaf	.79
HRC7-1A2T	SPST n.c.	Pin	.69

OTHER SENSITIVE SWITCHES

C-H8911K524 DPST n.o. Plunger..... .79
MuSwitch JDGBP32 SPST n.o. Plunger..... .95

TOGGLE & PUSH SWITCHES

Contacts	Mfgr. & No.	Description	Amps	Each
SPST	Carling	Small Toggle	3A, 110 V	.15
SPST	A, H&H	Toggle	3A, 250V	.29
SPST	C-H B5A	Aircraft	35A, 24V	.29
SPDT	C-H B9A	Aircraft	35A, 24V	.29
SPDT	A, H&H	Toggle	3A, 125V	.29
DPST	A, H&H	Toggle	3A, 125V	.39
1 B*	A, H&H	Momentary	3A, 125V	.22
1 B*	T&M Co.	Push	3A, 125V	.29
1 A*	Square D	Push	15A, 24V	.40
SPST	Circle F	Molded Toggle	6A, 125V	.35
SPST	A, H&H	Molded Toggle	6A, 125V	.35
DPDT	A, H&H	Molded Toggle	6A, 115V	.69
2Ba	C-H	C&B Aircraft	20A, 125V	.80
DPST	C-H	AN3023-2B	20A, 125V	.80
2DPT	C-H	5744K7	10A, 250V	1.95
3PST	C-H	5740-K4	10A, 250V	1.25
3PDT Center Off	C-H	5742K6	10A, 250V	2.00
4PDT Center Off	C-H	8006K828	10A, 250V	2.50

*1A=SPST n.o. 1B=SPST n.c.

20% off in lots of 100 or more

KOVAR GLASS TO METAL SEALS HIGH-VOLTAGE FEED THRU

Many types and sizes. Send us your blueprint or sample for our quote. Our prices are a fraction of original factory cost.

Sample Kit; 12 each of 8 Types 96 Seals $5.00 postpaid in U.S.

OVER 1000 DIFFERENT TYPES

HERMETICALLY SEALED RELAYS

Clare 5001; 24vdc; DPDT; 300 ohm; Octal Plug Base; #R678.....$5.95
Struthers-Dunn 181CXC100; 12vdc; 3As, 3Bs; #R679..... 5.95
Sigma 73351; 16vdc; SPDT; 2000 ohm; 8 ma; #R682..... 6.95
Sigma 7791; 3v; SPDT; 750 ohm; 4 ma; Octal Plug Base; #R683..... 6.95

D.C. SENSITIVE RELAYS

RBM 23025 6 ma., SPDT, 8000 ohm, #R428 ..... 1.50
W.E. (Whelock) KS9665 9 ma., 1A, 1B, 1C, 2000 ohm, #R426..... 4.95
Kurman Midget 12 ma., SPDT, 1500 ohm, #R427 ..... .98
Clare Type J (K102) 6 ma., SPDT, 3500 ohm, #R30 ..... 3.50
Dumont 5 ma., 1A, 5000 ohm #R230.. .98
Automatic 5035A7 8 ma., 1A, 1300 ohm, #103 ..... 1.25
Cooke Type C 4 ma., 1A, 6500 ohm, #R596 ..... 3.50
Claire B11613 (K101) 2 ma., SPDT, 6500 ohm, #R588 ..... 4.95
Clare A8053 8 ma., 3A, 6500 ohm, #R408 ..... 3.95
Potter-Brumfield; 9 ma; 2500 ohm, SPDT; 5 Amp Contacts; #R364.. 1.25
Potter-Brumfield; 5 ma; 5000 ohm; SPDT; 5 Amp Contacts; #684.... 1.50
RBM 452-1041; 4 ma; 12,000 ohm; DPDT; Telephone Type; #R685... 4.95

TS2A VARIABLE CERAMICONS

1.5 to 7; 1.5 to 7.5; 3.5 to 30; 5 to 40; 5 to 50; 7 to 45; 30 to 65 mmf (Types NPO & N-500)
35ea; 32.50/C; 300.00/M.
Also 12-62; 20-125 mmf...40 ea; 35.00/C.

TD2A DUAL CERAMICONS

2X4-30; 2X7-45 mmf.....60 pr; 54.00/C

CERAMIC & FEEDTHRU CAPACITORS

Type	No.	MMF Tol.	Ea.	per C
Button	FA	175±10%	.18	18.00
Button	FA	240±10%	.18	18.00
Button	FA	345±10%	.18	18.00
Button	FA	470±10%	.18	18.00
Disc		2000±10%	.40	30.00
Standoff	334	1000±10%	.12	10.00
Feedthru		55±10%	.10	9.00

324 CANAL ST. N. Y. C. 13, N. Y. • WAlker 5-9642
Universal general corp.
YOUR RELAY HEADQUARTERS

WANTED! WANTED!

MILITARY TEST SETS & EQUIPMENT

TS-12, 13, 35, 14, 15, 146, 174, 175, 263, 268, etc APR, ARC, ART, APS, APA, SCR, RC equipment and parts. Also TUBES, any quantity. WRITE, WIRE OR CALL.

R·H·S

SPECIALS OF THE MONTH

Coaxial Relay K-101 SPDT—24v DC8 ..... $ 4.95
Set of 83-1SP Coax-Connectors for Above 1.95
1000 KC Crystal BT cut 1.95
VB-2 Vacuum Switch 6.95
Sigma Plate Relay 8000 ohm SPDT 2.95
RG59/U Coaxial Cable—75 ohm
100' roll ..... $15.95. 200' roll 29.95
8" Scope Shield 1.29
2000-0-2000 V @ 800 MA stormer 24.95
15 HY @ 800 MA Choke 6.95
2 mfd 3000 V Condenser 4.95

TUBES!! BRAND NEW! STANDARD BRANDS! NO SECONDS! COMPARE! TUBES!!

OA2/VR75	$1.49	2C34	$2.25	217C	$6.95	832B	$6.90	8005	$7.95	WL-616	$37.50
OB2/VR90	1.29	2C37	4.95	227/CK27	5.95	8012	1.75	8015	1.75	WL-619	18.95
OC3/VR105	1.49	2C51/CIB	3.49	24AG	3.95	8013	1.95	WL-677	14.50	5Z4	.89
OD3/VR150	1.49	2D21	1.95	250B	12.95	8012	2.95	WL-681	22.50	6A2	1.75
1B22	3.48	3C21	2.25	250TH	22.50	8014	29.95	OA2	1.35	6A4LA	1.15
1B23	12.50	3CP1SI	2.95	275A	21.50	OA4G	1.25	6A6	.92	6B7	1.15
1B24	19.95	3DP1	4.95	276A	5.50	OB2	1.45	6A7	.95	6B7/7Y	1.15
1B26	3.95	3DP1-A	4.95	274B	2.65	OZ4	.79	6A8	1.05	6B7Y	1.25
1B27	34.50	3DP1-82A	8.95	276A	9.95	OA4	.73	6A8G	1.25	6B8	1.15
1B29	2.75	3D21A	1.95	293A	2.95	1A2	.73	6AC7GT	1.39	6B8G	1.15
1B35	6.95	3E29	24.75	304A	5.95	1A4P	1.39	6AD7	1.15	6B8GT	1.15
1B36	24.95	3FP7	2.95	300B	9.95	1A5GT	.79	6AD7GT	1.15	6C6GT	.98
1B38	32.50	3GP1	4.75	304TH	14.95	1A6	.85	6AF6G	.98	6C8G	1.15
1N21 Xtal	1.25	3HP7	2.95	304TL	14.95	1A7GT	.85	6AF6G	.98	6CB6	1.15
1N21A	2.95	4-65A	34.50	305A	34.50	1AB5	.98	6AG5	.89	6V6GT	.89
1N21B	4.25	4-125A	26.95	307A/RK75	5.95	1B3/8016	1.19	6AG7	1.15	6W6	.89
1N23	2.35	4-250A	29.95	310A	5.95	1B4	1.35	6AH6	1.49	6W7G	1.05
1N23B	3.25	4AP10	4.95	316A	.65	1B5/25S	.95	6AJ5	.79	6X4	.73
1N34A	2.25	4B32/EL32	9.95	323A/B	24.50	1B7GT	1.25	6AK5	1.05	6X5GT	.75
1N38	2.25	4B35/5CP7	7.95	323A/5CP7	24.50	1C5GT	.85	6AL5	.73	6Y6G	1.15
1N39	5.95	4B65/5CE	8.95	328A	8.95	1C6	.73	6AL5	.82	6Y7G	1.75
1N47	2.95	4B26/2000	8.95	331A	12.95	1C7G	.73	6AQ5	.79	6Z4/Y63	.79
1N34A	1.40	4B28	4.95	350A	8.95	1D8GP	.73	6AQ5A	.87	7A4/XX1	.79
1P22	1.49	4C27	4.95	354A	5.95	1D7G	.73	6AR5	.79	7A5	.95
1P34	1.79	4C27/CV92	9.95	368AB	7.95	1E5GP	.73	6AT6	.79	7A6	.95
1P35	2.95	4C35	34.50	371A	1.49	1E5GT	.73	6AU5	1.25	7A7	.95
1R5	6.95	4C37/250TH	24.95	371B	.98	1E7G	1.39	6AU6	.79	7A8	.95
2AP1 Xtal	11.95	5AP1	3.49	388A	2.75	1F4	.73	6AV6	.72	7AQ7	1.05
2C21/RK33	.49	5BP1	4.95	394A	.65	1F5G	.73	6AV6	.79	7B4	.89
2C22/7193	.49	5BP1	4.95	394A	6.95	1G4	.73	6B7	.98	7B5	.89
2C26A	.49	5CP1	4.95	417A	15.95	1G6GT	.73	6B8G	.98	7B6	.89
2C34/RK34	.49	5CP1	4.95	434A	4.95	1H4G	.73	6B8G	.98	7B7	.89
2C40	24.50	5C22	15.00	446A	4.95	1H5GT	.79	6BC5	.98	7C4	.79
2C40	12.95	5CP7	15.00	446B	4.95	1J6GT	1.05	6BE6	.98	7C5	.79
2C42	14.95	5DP1	24.50	450TH	47.50	1J6	.98	6BF6	.79	7C6	.98
2C44	1.49	5FP7	4.95	450TL	47.50	1K5	.73	6BG6G	1.75	7E5	.79
2C46	7.50	5GP1	4.95	527	12.75	1LA4	.49	6BH6	.97	7E6	.79
2C50	6.95	5JP1	20.45	531	1.95	1LA6	1.15	6BL7	.97	7E7	.79
2D21	1.79	5JP2	34.45	562	97.50	1LB4	1.05	6BQ6	1.15	7F7	.79
2D24	1.95	5LP1	34.45	575A	13.95	1LC6	.98	6C4	.79	7F8	.98
2E24	4.89	5J22	12.95	701A	5.95	1LC5	.98	6C5	.79	7H7	.79
2E26	2.95	5J23	24.50	703A	5.95	1LD5	.98	6C6	.79	7K7	1.35
2E30	2.29	5J26	39.50	704A	5.95	1LE3	.98	6C8G	.98	7L7	.98
2E31A	8.95	5J27	39.50	704A	1.65	1LG5	.85	6C8G	.98	7N7	.98
2J22	6.95	5JP1	39.50	705A	1.65	1LH4	.98	6D6	.79	7S7	.98
2J26	29.50	5NP1	5.95	706BY	15.50	1LN5	.98	6D8	.89	7W7	.98
2J27	29.50	5RP1	4.95	706CY	15.50	1P5GT	.73	6E5	.79	7X7	.98
2J30	99.50	6C21	34.50	706PY	42.50	1P6GT	.73	6F6	.98	7Y4	.89
2J31	99.50	6J4	6.95	707A	17.50	1Q5GT	.73	6F7	.89	7Y7	.98
2J32	39.50	6J4	6.95	707B	17.50	1R4	.73	6F8G	.89	7Z4	1.15
2J33	39.50	7DP7	17.95	708A	4.95	1R5	.85	6G6G	1.15	7Y4	.79
2J34	39.50	7DP4	17.95	709A	4.95	1S4	.73	6H6	.79	8D2	.98
2J35	57.50	8DP7	14.95	710A/8011	2.75	1S5	.98	6H6GT	.79	12A	.85
2J36	57.50	9LP1	14.95	713A	1.45	1T4	.73	6J5	.79	12A4	.85
2J38	12.75	9LP1	18.95	714AY	5.95	1T5GT	.73	6J5GT	.89	12A7	1.05
2J39	19.95	9MP1	18.95	715A	4.95	1U4	.73	6J6	1.25	12AQ5T	.79
2J40	29.50	10BP4	22.50	715B	5.75	1V	.72	6J7	.89	12AW7T	1.75
2J41	29.50	10	.49	715C	20.50	1X2	1.15	6K6GT	.89	12AL5	.79
2J42	29.50	12DP7	16.95	717A	1.49	2A3	1.25	6K6GT	.89	12AT6	.79
2J45	22.50	12FP7	16.95	721A	2.95	2A4G	1.25	6K7	.73	12AU7	1.25
2J46	22.50	12HP7	16.95	723A	2.95	2A5	.73	6K8	.73	12AT7	1.15
2J49	39.50	12LP4	32.50	723A/B	14.95	2A6	.73	6L6G	.87	12AU7	1.15
2J50	39.50	12LP1	32.50	724B	3.95	2B7	.73	6L6	1.25	12AV6	.79
2J51	49.50	15R	.39	724B	3.95	2D21	.73	6L6G	1.75	12BA6	.85
2J52	49.50	15DP4	42.50	725A	4.95	2E24/VP23	.73	6L6GC	2.25	12BE6	.79
2K25/		16CP4	42.50	726A	4.95	2X2	.65	6L7	.98	12C8	.79
723AB	29.95	16HP4	2.95	730B	5.95	2X2A	1.05	6L7G	.95	12F8GT	.79
2K28	36.75	22D4	.45	730A	20.50	2V3G	.98	6N7	.98	12H6	.85
2K29	34.50	24A Special	1.95	730TL	79.50	3A4	.98	6Q7	.98	12J6GT	.85
2K33	110.00	25T2	4.95	800	1.95	3B7/1291	.98	6S7	.98	12J7GT	.85
2AP1	12.95	45 Special	.39	801A	.49	3D6/1299	.98	6S7G	.98	12K7GT	.79
3B22/EB22	4.95	50L6	1.15	802	4.49	3E29	2.25	6SH7GT	1.15	12K8	.85
3B22/RK33	4.95	75TL	1.95	803	4.49	3Q4	.73	6SA7	.85	12K8	.85
3B24	4.95	100B	.89	804	4.49	3Q4GT	.73	6SC7	1.15	12Q7	.85
3B24W	7.95	100TH	5.95	805	4.49	3S4	.85	6SD7GT	.98	12SA7GT	.85
3B28	4.45	121A	2.95	806	29.95	3V4	.85	6SF5	.89	12SC7	.89
3B36	1.95	203A	8.95	807	1.95	5AS4GV	1.75	6SF7GT	.89	12SF5	.89
3B37	1.95	204A	69.50	808	7.2v	5T4	1.95	6SF7	.89	12SF7	.89
3B38	8.95	211	.89	809	2.45	5U4G	.73	6SG7	.98	12SG7	.79
3BP1	8.95	212E	49.50	810	1.95	5V4	.73	6SH7	.73	12SH7	.85
3C22	64.50	212A	.49	811	3.75	5Y3G	.49	6SJ7	.89	12SJ7	.79
3C23	9.95	218A	.49	812	2.95	5Y3GT	.49	6SK7	.89	12SK7	.98

5Y4G	$0.73	6SL7GT	$0.98	12SL7	$1.48
5Z3	.87	6SN7GT	.98	12SN7	.98
5Z4	.89	6SQ7	.75	12SQ7	.85
6A2	1.75	6SR7	.95	12SR7	.85
6A4LA	1.15	6SS7	.98	12Z3	.85
6A6	.92	6ST7	1.15	14A5	.98
6A7	.95	6ST7GTY	1.15	14A7	.98
6A8	1.05	6SV7	1.25	14S6	.95
6A8G	.92	6T6G	1.39	14S7	.98
6AC5GT	1.39	6T8	1.15	14Y7	.98
6AD7	1.15	6T8G	1.15	14Z7	.98
6AD7GT	1.15	6U8GT	.98	14Y7	.98
6AE5	.98	6V6	.89	14Z7	.98
6AF6G	.98	6V6GT	.89	14Q7	.98
6AG5	.89	6V6GT	.89	14R7	.98
6AH6	1.49	6W6	.89	19	.98
6AJ5	.79	6W7G	1.05	24A	.75
6AK5	1.05	6X4	.73	25L6GT	.98
6AL5	.73	6X5GT	.75	25Z5	.79
6AL5	.82	6Y6G	.98	25Z6GT	1.05
6AQ5	.79	6Y7G	1.75	26	.98
6AQ5A	.87	6Z4/Y63	.79	27	.98
6AR5	.79	7A4/XX1	.79	28D7	2.39
6AT6	.79	7A5	.95	30	.98
6AU5	1.25	7A6	.95	31	.98
6AU6	.79	7A7	.95	32	.98
6AV6	.72	7A8	.95	32L7GT	.98
6AV6	.79	7AQ7	1.05	33	.98
6B6G	.98	7B4	.89	34	.98
6B7	.98	7B5	.89	35/51	.98
6B8G	.98	7B6	.89	35A5	.98
6B8G	.98	7B7	.89	35L6GT	.98
6BC5	.98	7C4	.79	35Z5GT	.98
6BE6	.98	7C5	.79	35W4	.98
6BF6	.79	7C6	.98	35Y4	.98
6BG6G	1.75	7E5	.79	35Z3	.98
6BH6	.97	7E6	.79	35Z4	.98
6BL7	.97	7E7	.79	36	.98
6BQ6	1.15	7F7	.79	37	.98
6C4	.79	7F8	.98	38	.98
6C5	.79	7H7	.79	41	.73
6C6	.79	7K7	1.35	42	.98
6C8G	.98	7L7	.98	43	.73
6C8G	.98	7N7	.98	45	.73
6D6	.79	7S7	.98	46	.98
6D8	.89	7W7	.98	47	.98
6E5	.79	7X7	.98	48	.98
6F6	.98	7Y4	.89	49	.98
6F6G	.98	7Y7	.98	50A5	.98
6G6G	1.15	7Z4	1.15	50L6	.98
6H6	.79	8D2	.98	50L6GT	.98
6H6GT	.79	12A	.85	50Y6	.98
6J5	.79	12A4	.85	75	.98
6J5GT	.89	12A7	1.05	76	.98
6J6	1.25	12AQ5T	.79	77	.98
6J7	.89	12AW7T	1.75	78	.98
6K6GT	.89	12AL5	.79	79	.98
6K6GT	.89	12AT6	.79	80	.73
6K7	.73	12AU7	1.25	81	.98
6K8	.73	12AU7	1.15	82	.98
6L6G	.87	12AV6	.79	83	.98
6L6	1.25	12BA6	.85	83V	1.15
6L6G	1.75	12BE6	.79	84/6Z4	.85
6L6GC	2.25	12C8	.79	85	.98
6L7	.98	12F8GT	.79	86	.98
6L7G	.95	12H6	.85	87	.98
6N7	.98	12J6GT	.85	89	.98
6Q7	.98	12J7GT	.85	90	.73
6S7	.98	12K7GT	.79	91	.98
6S7G	.98	12K8	.85	92	.98
6SH7GT	1.15	12K8	.85	93	1.15
6SA7	.85	12Q7	.85	93V	1.15
6SC7	1.15	12SA7GT	.85	95	.98
6SD7GT	.98	12SC7	.89	99	.98
6SF5	.89	12SF5	.89	117L7/M7	1.39
6SF7GT	.89	12SF7	.89	117N7	1.35
6SF7	.89	12SG7	.79	117P7	1.35
6SG7	.98	12SH7	.85	117Z3	.89
6SH7	.73	12SJ7	.79	117Z6	.89
6SJ7	.89	12SK7	.98	117Z6	.98
6SK7	.89				

RADAR—COMMUNICATIONS—TEST EQUIPMENT

AN/APA10 Panoramic Adapter $175.00
AN/APA11 Pulse Analyzer.
AN/APN-4E Receiver 39.95
AN/APR4 Radar Search Receiver.
AN/APR5 Radar Search Rec. 1000-2,100mcs 375.00
AN/APS3 Airborne X-Band Search Radar 875.00
AN/APS10 X-Band R.F. Head 95.50
AN/APT5 800-1500 mc Xmitter 149.50
AN/CPT1 Dual Freq Victory Gibson Girl 139.50
COMPLETE YJ BEACON INSTALLATIONS 15.95
AN/PPN-1 Portable Radar Beacon.
BC221AK Freq. Mtr. with Modulation 149.50
BC-433G Compass Receiver 39.95
BC-433 Receiver 2.95
BC-449E 100-156 mcs ground xmitter 1395.00
BC-733D Receiver 29.95
BC-1031 Tape Code Recorder 495.00
BC-1206 Beacon Receiver 4.95
BM26V Compass Receiver 24.95
PE-75 24KW Gasoline Generators 450.00
RA-34 Power Supply 295.00
SCR210G Automatic Radio Compass.
SCR284 Portable U.F. 100 KC-65MC.
SCR522 Airborne VHF Transceiver.
SCR536 Hand-Talkie.
SCR694 Lightweight Field Radio.
SR-100 Radar Receiver Indicator 89.50
5-B Portable Radar 10 CM 895.00
T-30 Portable Radiotelegraph Xmitter 275.00
TCS Marine 2 Way Radio.
TWC-1 Complete Antenna System.
RA-42 Power Supply for SCR-522
MD-1/APS-3 Modulators with Tubes 65.00

ARA 500-1500KC Receiver, good $36.95
RCB/ARC-5 Receiver 29.95
RCA616 6-9 mcs. Receiver 24.95
RC433 200-1750KC Compass Rec. 29.95
ARR-7 256-268 mcs. Receiver 19.95
RC-454 2-6 mcs. Rec. w/tubes, New 12.95
T23/ARC-5 Xmitter 49.95
RC69G-A 2 mc Xmitter 9.95
TYPE O 6.3-7 mcs Xmitter 9.95
AVT-22 300-15,000KC Complete, New 79.50
RC-298A 100-156 mcs. Xmitter, New 89.95
RC-466 Modulator, good 3.95
RC-468 Control Box (2 Rec.) used 1.25
RC-467 Relay Unit (Ant) used 1.95
RC-451 Control Box (Xmitter) used ..... .98

FLEXIBLE SHAFTING AVAILABLE.

HRU-29 28V 2000W Gasoline Generator
RC-34/Coastal Cable, Per Thousand Feet $25.00
SCR-518 Altimeter, Complete installation 29.95
SCR-522 Trans./Rec. Complete installation 28V Input, 12V input avail. 139.50
RCA Sound Powered Chest & Headsets, Pair 29.95
LARGE QUANTITY PE-104 VIBRAPACK FOR SCR-284
NEW EXPORT PACKED
MS-38 Headsets.
FT-154 (BC-348 Shock Mount).
MS-33 Headsets.
BC-686 Automatic Keyer for SCR522.
BC1206 Lighthouse Tube Transmitter.
APA-17 D.F. Antenna. 300-1000 MC.
BC-306 Interphone Amplifier.
ART-13 Loading Condenser.
CU-28 Loading Box for Ars-13.
AS-37/ARN5 Antenna.
5A-1/ARN-1
10-59/APA-17 Indicator.
RM-29 Remote Control.
RA-309 FM Exciter.
A-84 Dummy Antenna.
BC-1365 Control Box.
FL-8 Filter.
FL-9 Filter less Cables.
3C-16D GSAP Gun Camera Computer, complete.
AT-2/APN-2 Antenna.
CC-372/173/CPN-8 10CM Patch Cable.

TS3/AP S-Band Freq & Power Meter.
TS10/APW Altimeter Test Set, Ex. ..... $ 35.00
TS11/AP
TS12/AP V.S.W.R. Test Set for X-Band.
TS13/AP XA Band Sig Gen Pwr & Freq Mtr.
TS14/AP SA Band Sig Gen.
TS15/AP Flux Meter.
TS16/AP-2 Altimeter Test Set. ..... $ 29.95
TS19/APQS Range Calibrator.
TS23/APH Test Set for BC-1218 Altimeter.
TS32/TRC-1 70-100 mcs Sig Gen used to check ANTRAC Equipment.
TS33/AP X-Band Freq. Meter.
TS34/AP Synchroscope.
TS35/AP X-Band Sig Gen Pwr Mtr Freq Mtr.
TS36/AP X-Band Power Meter.
TS45/AP S-Band Sig Gen.
TS47/APR Sig Gen 60-500 Mcs.
TS59/APN Altimeter Test Set.
TS61/AP S-Band Echo Box. $140.00
TS62/AP X-Band Echo Box.
TS67/AP I.L.S. Test Set.
TS69/AP Freq. Mtr. 300-1000 mcs. ..... $ 72.50
TS89/AP Voltage Divider.
TS102/AP Range Calibrator.
TS110/AP Echo Box.
TS112/AP S-Band Freq. Meter.
TS125/AP S-Band Power Meter.
TS126/AP Synchroscope.
TS155/UP S-Band Sig Gen Pwr Mtr Freq. Mtr.
TS164/AR A.C. Version of BC221.
TS170/ARN I.L.S. Test Set.
TS174/AP Freq. Mtr. 60-600 Mcs. $195.00
TS175/AP Freq. Mtr. 800-1080 mcs.
TS184/AP
TS185/AP
TS226/AP 200-1000 mcs Pwr Mtr
TS266 Xtal Diode Test Set.
TS272/AP AN/APS13 Test Set
BC-221 Frequency Meter.
1E-19 Test Set for SCR522.
1E-36 Test Set for SCR522.

SO-13 S-BAND MARINE RADAR

Compact Sea Search Radar for small vessels. P.P.I. indication is provided. Complete in original cases with complete sets of spares. Excellent condition.

AN/ARC-1 TRANS/REC.

Provides Radio-Telephone Communication between Aircraft or Aircraft & Ground. Complete with Shock Mount & Control Box. Input: 28V DC. Excellent condition. Available in either 10 or 20 Crystal Controlled Channels 100-156 MCS. checked out.

TELETYPEWRITER SERVICE NY1-771

WE NOW OFFER THIS CONVENIENCE TO OUR CUSTOMERS. SEND YOUR REQUESTS AND ORDERS FOR TUBES, EQUIPMENT, TEST SETS, PARTS, ETC. TO NY1-771.

RADIO HAM SHACK Inc.

189 GREENWICH STREET . NEW YORK, N. Y.

Phone Digby 9-0347
CABLE ADDRESS: HAMSHACK NEWYORK

Prices subject to change without notice. F.O.B. NYC, minimum order $10.00. 25% deposit required. All merchandise guaranteed.

IMMEDIATE DELIVERY • LOW PRICES • FULLY GUARANTEED

MOTOR SPECIALS
BODINE NSHG-12 MOTOR
Constant Speed

27 v. D-C Governor controlled 3000 rpm. 1/30th hp. Stock #SA-39. **Price $17.50 each.**

DELCO CONSTANT SPEED MOTOR A-7155

1/30 hp. 27.5 v d-c 3600 rpm. Cont. duty. 2⅛" diam. x 5⅛" lg. ⅜" shaft extension, 5/32" diam. 4 hole base mounting. Stock #SA-94. **Price $12.50 each**

JA1 MOTOR (D-C)

Electric Specialty. ¼ hp. 24 v. D-C. (Wing flap motor.) Stock #SA-325. **Price $19.50 ea.**

¾ HP DC MOTOR
Electric Specialty Co. HOA315T.

24 volts DC. 3800 rpm. Stock #SA-321. **Special Price $24.50 each**

DC Motor Special

1¾ hp. 28 v. DC. motor. Magnetic brake. Electric Specialty Co. type HCA32B. **Large Qty. Available.**

Dumore DC Motor

Type E1Y2PB. 24 v. DC @ 5.0 Amps. Model 1023-263. Gear Head. 300 rpm. 10 min. 0.05 hp. Stock #SA-316. **Price $12.75 each.**

PERMANENT MAGNET GEARHEAD MOTORS

Delco type 5069000—27.5 v. DC. 250 rpm output shaft speed. 12 in/oz.
Delco type 5071895—27.5 VDC. 250 rpm.
Delco type 5069230—27.5 VDC. 145 rpm.

AC-SERVO MOTORS
PIONEER CK-17

400 cycles, 2 phases, 26 v. fixed phase. 45 v. max. variable phase. Built in gear reduction. Output shaft speed approx. 4 rpm. Stock #SA-287. **Price $16.50 each.**

FORD SERVO MOTOR

115 volt 60 cycle two phase low inertia motor. 15 watts output. BuOrd. 207927. Stock #SA-291. **Price $49.50 each.**

Pioneer Servo Motor

Type 10047-2A. 2 ϕ 400 cycle low inertia. 26 v fixed phase. 45 v. max. variable phase. Stock #SA-90. **Price $12.50 each.**

C1B THYRATRON

Special offer — Large quantity C1B thyratrons available. New, original packing. Write for quantity quotation.

1 H.P. VARIABLE SPEED DRIVE
Louis Allis Adjusto-Spede

Squirrel Cage A-C motor and an electromagnetic clutch and pilot governor. Speed range 0-1050 rpm. Three phase. 208 v. operation. 60 cycles. DC excitation 0-10 volts. Small quantity available.

— SERVO SPECIAL —
Low Inertia Servo Motor
400 Watts Output

115 volt 2 ph. 2 pole. 60 cy. Mfd. by Pioneer-Bendix.

Uses built in Fan Motor.

Navy Type CM-211518A W.E. KS-151182L1
Small Qty. only

MAGNETIC AMPLIFIER
Pioneer Type 12077

115 V. 400 cy. One Tube Servo Amplifier using saturable reactor type output transformer.

Limited Quantity

SELSYN SPECIAL

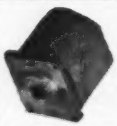
General Electric 2J1F3

115 v. 400 cycle Selsyn Generator. Large quantity. **Prices on request**

OSTER MOTOR

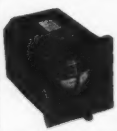
John Oster Type B-9-1 motor with dual output shaft gear reduction. Cam operated linear motion translation. Motor 27.5 v. DC at 0.7 Amps. 5600 rpm. Stock #SA-335. **Price $9.75 each.**

REVERE CAMERA MOTOR



27 v. D-C Split field series. Approx. 2⅛" sq. x 2½" lg. Stock #SA-315. **Price $6.75 each.**

Indicator Attitude Gyro



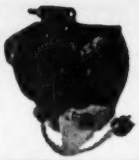
Sperry No. 659644. Gov't. No. R-86-1-1310 Three phase 115 v. 400 cycle. Navy overhauled May 1950. **Prices on request.**

SYNCHROS-SELSYNS

1SF, 5G, 5F, 5CT, 5HCT, 5SDG, 5DG, 5SG, 5SF, 5HSF, 6G, 6DG, 7G, 2J1F1, 2J1G1, 2J1H1, 2J5FB1, 2J5R1, 2J1" F3, XX1, X, XV, VII, II, 5V, etc.

MAGNESYNS

Pioneer Type CL-3, 6 power.
Pioneer 1006-1E-B1 Indicator. AN-5730-2.



BLOWER ASSEMBLY
WESTINGHOUSE FL Blower

115 v. 400 cy. 17 c.f.m. Includes capacitor. Stock #SA-144. **Price $14.50 ea.**

Radio Compass Indicator I-82F. Compass Indicator. 0-360°-5 in. dial. 26 v. 400 cy. 8-12 v. 60 cy. Ideal position indicator. Stock #SA-324. **Price $6.50 each**

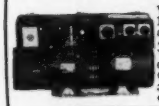
PRECISION AUTOSYN

Pioneer Type AY-150 Control Autosyn. Precision type. 26 v. 400 cycle. Stock #SA-297. **Special low price $14.50 each.**

CONSTANT VOLTAGE TRANSFORMER
One only.

Sola No. 30710. Dual voltage primary 95-125/190-250 volts. Secondary 115 volts 60 cycles at 17.4 Amps. 2000 VA. **Special Price $145.00.**

INVERTERS



WinchargerPU-7/AP Input 28 VDC at 160 amps. Output 115 v. 400 cy. 1 ϕ at 2500 VA. Voltage and frequency, regulated. Cont. duty. Stock #SA-164. **Price $89.50 each.**

G.E. 5AS131NJ3 (PE-113) Input 26 VDC at 100 amps. Output 115 v. 400 cy. 1 ϕ at 1500 VA. PF 0.8 W.E. Spec. KS-5601L1. Stock #SA-286. **Price $29.50 ea.**

PE-218EInverters Russell Electric and Leland. Input 28 VDC at 92 amp. Output 115 v. 400 cycles at 1500 VA. PF 0.9. Stock #SA-112A. **Price $49.50 each.**

Pioneer 12130-4-B Input 28 VDC at 14 amps. Output 120 v. 400 cy. single phase at 1.15 amps. (140 VA.) Voltage and frequency regulated. Made 1949. Stock #SA-304. **Price $89.50 each.**

Leland SD-93—(10285)—Input 28 volts DC at 60 amps. Output 115 volts three phase 400 cycles at 750 va. 0.90 P.F. Second output voltage of 26 volts 400 cycles at 50 V.A. Voltage and frequency regulated. Designed for use with various autopilots. Stock #SA-209. **Price $99.50 each**

D-C ALNICO FIELD MOTORS

WRITE FOR LISTING
Prices F.O.B. Paterson
Phone ARmory 4-3366

Servo-Tek products co.
4 Godwin Ave. Paterson, N. J.

SPECIALISTS IN FRACTIONAL HORSE POWER MOTOR SPEED CONTROL

A LEADING SUPPLIER OF ELECTRONIC & AIRCRAFT EQUIPMENT

IMMEDIATE DELIVERY -- FULLY GUARANTEED

A C MOTORS

TELECHRON SYNCHRONOUS MOTOR, Type B3, 110 V., 60 Cy., 4 W., 2 RPM. PRICE $5.00 EA.

TELECHRON SYNCHRONOUS MOTOR Type BC, 110 V., 60 Cy., 6 W., 60 RPM. PRICE $4.00 EA.

EASTERN AIR DEVICES, Type J33, Synchronous, 115 V., 400 Cy., 3φ, 8000 RPM. PRICE $15.00 EA.

HAYDON TIMING MOTORS 110 V., 60 CY.

Type 1600, 2.2 W., 4/5 RPM. PRICE $3.00 EA.

TPE 1600, 2.2 W., 1/240 RPM. PRICE $3.00 EA.

TYPE 1600, 2.3 W., 1 RPM. PRICE $3.00 EA.

TYPE 1600, 2.2 W., 1-1/5 RPM. PRICE $3.00 EA.

TYPE 1600, 3.5 W., 1 RPM., With shift unit automatic engaging and disengaging shaft. PRICE $3.75 EA.

TYPE 1600, 2.2 W., 1/60 RPM. PRICE $3.00 EA.

SERVO MOTORS

CK1, PIONEER, 2 φ 400 Cy. PRICE $10.00 EA.

CK2, PIONEER, 2 φ, 400 Cy. PRICE $14.00 EA.

CK2, PIONEER, 2 φ, 400 Cy., with 40:1 reduction gear. PRICE $15.50 EA.

10047-2-A, PIONEER, 2 φ, 400 Cy., with 40:1 reduction gear PRICE $10.00 EA.

MINNEAPOLIS HONEYWELL Type B, Part No. G303AY, 115 V., 400 Cy., 2 φ, built-in reduction gear, 50 lbs. in torque. PRICE $10.00 EA.

MINNEAPOLIS HONEYWELL Amplifier Type G403, 115 V., 400 Cy., Used with above motor. PRICE $10.00 EA. WITH TUBES

REMOTE INDICATING COMPASSES 26 V., 400 CY.

PIONEER TYPE AN5730-2 Indicator and AN5730-3 Transmitter. PRICE $40.00 PER SET

KOLLSMAN TPE 680K-03 Indicator and 679-01 Transmitter. PRICE $15.00 PER SET

D C MOTORS

DELCO MOTOR, TYPE 5068750, 27 V., D.C., 160 R.P.M., with Brake. Price $22.50 EA.

JAEGER WATCH CO. TYPE 44K-2 Contactor Motor, 3 to 4.5 V. Makes one contact per second. PRICE $3.50 EA.

GENERAL ELECTRIC TYPE 5BA10AJ37, 27 V., 0.5 amps., 8 oz. in torque, 250 RPM. PRICE $10.00 EA.

BARBER-COLMAN CONTROL MOTOR, Type AYLC 5091, 27 V., 0.7 Amps., 1 RPM. Contains 2 adj. limit switches. 500 in. lbs. torque. PRICE $9.50 EA.

WHITE RODGERS ELECTRIC CO., Type 6905 No. 3, 12 V., 1.3 Amps., 1½ RPM, torque 75 in. lbs. PRICE $10.50 EA.

ENGINE HOUR METER

John W. Hobbs Model MI-277. Records running time up 1000 hours. 20 to 30 volts D.C. PRICE $13.50 EA.

INVERTERS

WINCHARGER CORP. PU-16/AP, MG750. Input 24 V. D.C., 60 Amps. Output 115 V., 400 Cy., 1 φ, 6.5 Amps. PRICE $100.00 EA.

HOLTZER CABOT TYPE 149F, Input 24 V. D.C. at 36 Amps., Output 26 V. at 250 V.A., 400 Cy., and 115 V., 400 Cy., at 300 V.A., 1 φ. PRICE $75.00 EA.

PIONEER TYPE 12117. Input 12 V. D.C., Output 26 V., 400 Cy. at 6 V.A. PRICE $30.00 EA.

PIONEER TYPE 12117. Input 24 V. D.C., Output 26 V., 400 Cy. at 6 V.A. PRICE $30.00 EA.

PIONEER TYPE 12116-2-A. Input 24 V. D.C., at 5 Amps. Output 115 V., 400 Cy., 1 φ at 45 watts. PRICE $100.00 EA.

GENERAL ELECTRIC TYPE 5D21NJ3A. Input 24 V. D.C. at 35 Amps. Output 115V., 400 Cy., 485 V.A., 1 φ. PRICE $35.00 EA.

LELAND PE 218. Input 24 V. D.C. at 90 Amps. Output 115 V., 400 Cy., 1 φ at 1.5 K.V.A. PRICE $47.50 EA.

PIONEER AUTOSYNS

TYPE AY1, 26 V., 400 Cy. PRICE $8.50 EA.

TYPE AY5, 26 V., 400 Cy. PRICE $8.50 EA.

TYPE AY14G, 26 V., 400 Cy. PRICE $15.00 EA.

TYPE AY 14D, 26 V., 400 Cy. PRICE $15.00 EA.

TYPE AY54D, 26 V., 400 Cy. PRICE $10.00 EA.

TYPE AY131D Precision Autosyn. PRICE $35.00 EA.

PIONEER AUTOSYN POSITION INDICATORS & TRANSMITTERS

TYPE 5907-17. Dial graduated 0 to 360°, 26 V., 400 Cy. PRICE $30.00 EA.

TYPE 6007-39. Dual Dial graduated 0 to 360°, 26 V., 400 Cy. PRICE $50.00 EA.

TYPE 4550-2-A Transmitter, 26 V., 400 Cy., 2:1 gear ratio. PRICE $20.00 EA.

VOLTAGE REGULATORS

LELAND ELECTRIC CO. TYPE B, Carbon Pile type. Input 21 to 30 V. D.C. Regulated output 18.25 at 5 Amps. PRICE $6.50 EA.

WESTERN ELECTRIC TRANSTAT VOLTAGE REGULATOR Spec. No. V-122855, Load K.V.A. 0.5. Input 115 V., 400 Cy. Output adjustable from 92 to 115 V PRICE $10.50 EA.

RATE OR TACHOMETER GENERATORS

EASTERN AIR DEVICES J36A, .02 V. D.C. per RPM. Max. speed 5000 RPM. PRICE $17.50 EA.

ELECTRIC INDICATOR CO. TYPE B6B Rotation Indicator, 110 V., 60 Cy., 1 φ. PRICE $14.00 EA.

GENERAL ELECTRIC TACHOMETER GENERATOR TYPE AN5531-1. Variable frequency, 3 φ output. PRICE $25.00 EA.

GENERAL ELECTRIC TACHOMETER GENERATOR TYPE AN5531-2. Variable frequency, 3 φ output. PRICE $30.00 EA.

ALL PRICES F. O. B. GREAT NECK N. Y.

SYNCHROS

1F SPECIAL REPEATER, 115 V., 400 Cy. PRICE $20.00 EA.

2J1F3 GENERATOR, 115 V., 400 Cy. PRICE $10.00 EA.

2J1G1 CONTROL TRANSFORMER, 57.5/57.5 V., 400 Cy PRICE $10.00 EA.

2J1F1 GENERATOR, 115 V., 400 Cy. PRICE $10.00 EA.

2J1H1 DIFFERENTIAL GENERATOR 57.5/57.5 V., 400 Cy. PRICE $10.00 EA.

5SDG DIFFERENTIAL GENERATOR, 90/90 V., 400 Cy. PRICE $20.00 EA.

5G GENERATOR, 115 V., 60 Cy. PRICE $50.00 EA.

W. E. KS-5950-L2 Size 5G, 115 V, 400 Cy. PRICE $10.00 EA.

D C ALNICO FIELD MOTORS

DIEHL TYPE S.S. FD6-23, 27 V., 10,000 RPM. PRICE $10.00 EA.

DELCO TYPE 5069466, 27 V., 10,000 RPM. PRICE $15.00 EA.

DELCO TYPE 5069370, 27 V., 10,000 RPM. PRICE $15.00 EA.

DELCO TYPE 5072400, 27 V., 10,000 RPM. PRICE $15.00 EA.

BLOWER ASSEMBLIES

JOHN OSTER TYPE MX215/APG, 28 V. D.C., 7,000 RPM, 1/100 H.P. PRICE $10.00

WESTINGHOUSE TYPE FL, 115 V., 400 Cy., 6,700 RPM, Airflow 17 C.F.M. PRICE $10.00 EA.

DELCO TYPE 5068571 Motor and Blower Assembly, P.M. Motor, 27 V., 10,000 RPM. PRICE $15.00 EA.

GENERAL ELECTRIC D C SELSYNS

8TJ9-PAB, TRANSMITTER, 24 V. PRICE $4.50 EA.

8DJ11-PCY, INDICATOR, 24 V. Dial marked −10° to +65°. PRICE $6.00 EA.

8DJ11-PCY, INDICATOR, 24 V. Dial marked 0 to 360°. PRICE $7.50 EA.

RECTIFIER POWER SUPPLY

Hammett Electric Mfg. Co., Model SPS-130, Input Voltage AC 208 or 230, 60 cycle, 3 phase, 21 amps. Output 28 Volts, 130 amps, continuous duty. 37" high, 22½" wide, 21" deep. Contains DC Volt meter, DC amp meter and 8 point tap switch for variable output voltage. Brand new. Price $350.00.

MISCELLANEOUS

SPERRY A5 CONTROL UNIT, Part No. 644836. PRICE $7.50 EA.

SPERRY A5 AZIMUTH FOLLOW-UP AMPLIFIER, Part No. 656030, with tubes. PRICE $5.50 EA.

SPERRY A5 DIRECTIONAL GYRO, Part No. 656029, 115 V., 400 Cy., 3 φ. PRICE $25.00 EA.

PIONEER TYPE 12800-1 GYRO SERVO UNIT. 115 V., 400 Cy., 3 φ. PRICE $20.00 EA.

ALLEN CALCULATOR TYPE C1 TURN & BANK INDICATOR, Part No. 21500, 28 V. D.C. PRICE $15.00 EA.

TYPE C1 AUTO-PILOT FORMATION STICK, Part No. G1080A3. PRICE $15.00 EA.

PIONEER GYRO FLUX GATE AMPLIFIER Type 12076-1-A, 115 V., 400 Cy. PRICE $40.00 EA.

INSTRUMENT ASSOCIATES

363 GREAT NECK ROAD, GREAT NECK, N. Y.

Telephone GReat Neck 4-1147

Write for Catalog NE100

U. S. Export License-2140

Western Union address: WUX Great Neck, N. Y.

RADAR — COMMUNICATIONS

TYPEWRITER WELL

Heavy Duty Standard Panel, 19" x 10½"W x ⅝", tough steel supporting metal desk well 20" x 15" wide x 4¼" deep. Ideal for that new, compact rig. Space saving panel may be used to support extra equipment. Attractive gray finish. New. Only a few left $4.95

OIL CONDENSERS			MOTOR START. COND.		
Mfd.	Volt.	Price	Cap	Vac.	Price
5	50	$0.45	13-15	220-	$1.20
650	80	1.95	20-24	110-	1.00
15	220AC	2.20	26-36	220-	1.35
0.5	75vAC	1.59	45-65	110-	1.25
0.5	1000	.69	43-48	110-	1.25
2x0.5	1000	.70	50-75	110-	1.25
1	1000	.75	53-640	220-	1.50
1.5	1000	.85	61-63	220-	1.60
2	1000	.90	64-72	110-	1.25
4	1000	1.75	72-87	110-	1.25
2x.01	1200	1.35	75-84	110-	1.25
1	1500	1.30	88-106	110-	1.50
1.5	1500	1.40	107-129	110-	1.65
2	1500	1.45	130-157	110-	1.75
0.15	4600	1.20	130-156	70-	1.50
2x0.1	4800	1.20	135-180	110-	1.85
0.1	6000	1.30	158-189	110-	1.85
1.5	6000	17.50	161-193	110-	1.75
2x0.1	7000	2.95	185-216	110-	1.95
.015	16000	1.95	200-220	110-	1.95
.0016	15000	5.95	270-300	110-	2.10
.25	20000		324-360	110-	2.40
1	25000		378-420	175-	3.80
.5	25000		432-480	110-	2.75
1	7500		485-540	110-	2.85

MANY OTHERS

DYNAMOTORS

Type	Input Volts	Amps	Output Volts	Amps.	Radio Set
PE-73	28	1.25	250	.060	RC36
DM416	14	6.2	330	.170	RU 9
DM33A	28	7	540	.250	BC 456
PE101C	13/28	12.6	400	.135	SCR 515
		6.3	450	.120	
GD AR 93	28	1.25	375	.150	
23350	27	1.75	285	.075	APN-1
ZA6015	12/24	4/2	500	.060	
B-19 Mock	12	9.4	275	.110	MARK II
			500	.050	
D-104	12		220	.150	
			440	.200	
DA-3A	28	10	300	.060	SCR 522
			150	.010	
			14.5	.5	
5053	28	1.4	250	.060	APN-1
PE73CM	28	15	1000	.350	BC 375
CWZ1AAX	28	12.6	400	.135	
	26	6.3	800	.020	
			9	1.12	
PE94	28	10	300	.200	SCR 522
			150	.101	
			14.5	.5	

INVERTERS

PE-218-E: Input: 25 28 vdc. 92 amp. Output: 115 v. 350-500 cy 1500 volt-amperes. Dim. 17"x6½"x10". New $34.50

PE-218-H: Same as above except size: 10½"x6"x10". New $34.50

PE-206: Input: 28 vdc, 38 amps. Output: 80 v 800-cy, 500 volt-amps. Dim: 13"x5½"x10½". New $22.50

MG 140F. Input: 24 vdc, 30A. Output: 26 v @ 320 va, 400 cy, and 115 v @ 400 cy—500 va 1 phase.... $75.00

AUDIO TRANSFORMERS

AT501 Hi-Fi Special: PRI: 3000 ohms P-P/Sec: 4/16/12/50/200 ohms 60-10,000 CY.—1 db 50W $3.49

AT152 Hi-Fi Driver Pri: 10,000 ohms Sec: 40,000 ohms PP Grids 50-15 KC/1 db-50W $1.49

AT063 Output to H.S. or line PRI: 14,200 ohms SEC: 8000/600 ohms 1.19

AT448 Hi-Fi Driver (5000 ohms) to P.P. output grids (4,000 ohms) 100-10,000 CY. 10 W. 6V6 to PP 805's $2.39

AT666 Intercon Input: Spkr (4-8 ohms) to grid (250,000 ohms) $0.89

AT415 Plate (18,000 ohms C.T.) to line (125 ohms) 175 w.—500-600 CY. $1.98

AT858 Plate (10,000 ohms C.T.) to line V.C. (500/125130 ohms) HI-FI—50 W. $6.95

AT070 Mike-or-Line (250 ohms) to grid (250,000 ohms C.T.) $1.29

AT765 Mike-or-Line (600 ohms) to grid (50,000 ohms C.T.) $0.89

AT-671 Universal Output—10W Hi-Fi.

PRI: 20,000 Ohms P-P/10,000 Ohms P-P also 5000/4000 ohms. Single End.

SEC. 500/15/7.5/3.75/1.25 ohms. Response: Flat P.M. 1 d.b. 50-20,000 Cycles $4.75

AT-694 Hi-Fi Output: 3 Watts. 8500 Ohms P-P to V.C. (15 Ohms) 15-15KC PM 1 db. $1.49

AT4-A1: Mike (35 ohm Carbon) to Line 600 ohm/200 ohm $1.19

AT 649: Line (500 ohms) to Grid (75K ohms) ..... .89¢

AT 448: Line (600 ohms) to V.C. (6 ohms) 17 d.b. Level $1.49

AT 631: Mike-or-Line (200 ohms) To Single or P-P Grids (50K Ohms) ..... .59¢

AT 718 Line (300 ohms) to Line (600/30 Ohm) Response 50-20KC P.M. 1 db. ..... .49¢

TUBES! VACUUM TUBES TUBES!

01A	.66	12HP7	14.45	723A	9.75
2C21	.66	12SH7	.79	723A/B	17.95
2C22	.54	12SR7	.79	724B	3.15
2J21A	14.95	15E	.98	725A	7.95
2J22	14.95	15R	.75	726A	8.75
2J24	24.50	23D4	.42	730A	37.50
2J27	21.50	35/51	.74	800	1.45
2J31	29.75	38	.54	801-A	.44
2J32	38.75	35/44	.52	809	2.35
2J38		45S	.32	837	1.65
2J39	47.50	227A	4.39	838	3.25
2J49	59.50	6C27	4.39	868	
2J61	54.50	355A	14.00	861	23.50
2J62	48.50	417A	8.75	875	1.45
3B24W	5.25	531	3.45	931	.75
3BP1	4.95	559	.98	1619	.28
3CP1	2.25	615	.44	1625	.39
3C23	9.95	700-A	23.50	1626	.39
3C30		700-B	23.50	1629	.39
3DP1	3.95	700-C	23.50	1961	4.75
3EP1	3.95	703-A	6.75	5011A	4.85
3FP7	2.19	704-A	.83	5894	.49
3J31	85.80	705-A	2.45	9006	.27
4C27	9.75	706-AY	42.50	GL697	
4J38	87.50	706BY	37.50	HH70	.27
5FP7	2.95	706CY	37.50	QK60	85.00
5GP1	4.75	706EY	44.50	QK61	85.00
5J23	12.75	715B	15.95	QK62	85.00
5J30	24.50	717A	3.25	VR91	1.45
6U5/6U5G	.89	718DY	44.50	WL530	9.95
10Y	.42	719A	24.50		

IE-12

SCR 522 TEST SET-UP

CONTAINS SIG. GEN. 1-96, F.S. METER 1-95, RCVR.-XMTR. SCR 522, ALSO CONTROL BOXES, CABLES, ALL CRYSTALS, DYNAMOTOR, TOOL SET, INSTRUCTION MANUAL, ETC. BRAND NEW, COMPLETE ..... $1295.

SPECIALS

BC 506 ANTENNA TUNING UNIT, NEW..... $6.95
RD/APN-4, New, With Tubes..... $75.00
RDE/APN-4, New, With Tubes and Crystal..... $75.00
A-62 Phantom Antennae..... $0.50
2 Meter Choke, 1000 MA, 20-144..... $/$1.00
Supersonic Crystal Head, M-1, 22-27KC HI-S..... $27.48
Underwater Microphone, Model JR, Z=50ω..... $24.50
Dynamic Mike & Headset Combo. B-19. New..... $3.75
HS-30 Inserts, M-300..... $3.50 per M
Motors, 3 RPM—115V, 60 Cy..... $1.85
AN/ARC-4 VHF Trans-Rcvr..... $75.00
IE 38 Test Set, New..... $37.50
SCR 274 Test Set, TS-104..... $42.25
Time Delay Relay, 45 Sec. 115VAC-DC 10A..... $2.29
Carbon Pile Reg., 18Y-.5Y #25X025..... .75
ART-13 Driver Trans. 6V6 to P-P 811's..... $1.29
DM 34 Dynamotor, 14V In. 220V. 80 MA out.....
Sens. Relay: 3.5MA, 13K ohms, 2PST, 2A..... $1.29
Klixon Breaker: Thermal, 35A..... .69
T-30 Carbon Mikes. New..... .89
Screen Mod. Trans. for 807's..... $1.19
3-4 MC Coils for ARC-5 #6029, #7247..... Set $2.79
400 Cy Volt Reg. RH Transtat. In: 115V, 400 Cy. Out: 75-120V. 6A..... $12.75
BC 1203 Pulse Test Set for SCR 535..... $175.00

SELENIUM RECTIFIERS

UP TO 32 VAC IN— UP TO 14 VDC	OUT
2A	$2.50
4A	4.00
6A	6.00
10A	7.50
12A	9.00
24A	18.00
UP TO 36 VAC IN— UP TO 28VDC	OUT
1A	$3.00
2A	4.00
4A	8.00
10A	14.00
12A	18.00
24A	36.00
UP TO 64 VAC IN— UP TO 42 VDC	OUT
2A	$6.50
4A	8.50
UP TO 128 VAC IN —UP TO 100 VDC	OUT
2A	$11.00
10A	48.00
12A	60.00

Special Rectifiers On Request

Hi-Current Chokes

1 HY—12 Amp—46 Ohms $16.95
.01 HY—2.5 Amp—Cased $2.25

LO-VOLT. XFMRS Primaries 115v, 60 Cycle

56V-40V at 2.5 amps $3.75
24v-1.5A 1.95
6v-1.5A ..... .98
16v-5A 3.75
12v-5A 3.75

HI CAP. FILTER CONDENSERS

Cap.	WVDC	Price
800	15	$1.35
2600	6	1.45
500	200	2.80
250	150	1.45

PRECISION RESISTORS

OHMS	OHMS	OHMS
5	150	7,500
5.05	250	10,000
10	430	12,000
18	460	17,000
82	800	20,000
120	930	30,000
125	1100	35,000
128	4300	84,000

30c EACH....10 FOR $2.50
100K 120K 150K 220K
40c EACH....10 FOR $3.50
1 MEGOHM.....EACH 75c

MAGNETRONS

Tube	
2J27	2J62
2J31	3J31
2J38	5J30
2J21-A	718DY
2J22	720BY
2J26	725-A
2J32	730-A
2J38 Pkg.	QK 62
2J39 Pkg.	QK 59
2J49	QK 61
2J61	QK 69

700 A, B, C, D
706 AY, BY, DY, EY, FY, GY

UNIVERSAL POWER TRANSFORMER

Pri: Vibrator Input @ 6/12/24/110 VDC, AC Input: 110/220 V. @ 60 CY.
Sec: 250-0-250 V—40 MA. 6.3V—1.8A.
Ea. $1.49

POWER TRANSFORMERS

Comb. Transformers—115V/50-60 cps input.

CT-341	1050V/10 MA. —625V @ 5 MA, 26V @ 4.5A 2x2.5V/3A, 6.3V @ 3A		$22.50
CT-77B	5500V/.002A, 2.5V/2A 12KV TEST 6.3VCT/.6A—4600V TEST		12.95
CR-825	360VCT	.340	6.3VCT/3.6A, 6.3VCT/3A	3.95
CT-626	1500V	.160	2.5/12. 30/100	9.95
CT-15A	350VCT	.070	6.3/.6. 6.3/1 & 2 lbs	2.95
CT-071	110V	.200	33/200. 5V/10, 2.5/10	4.95
CT 378	2300V	4 MA	2.5/2	6.95
CT-367	580VCT	.050	5VCT/3A	2.25
CT-721	550VCT	.100	6.3/1. 2.5VCT/2	2.95
CT-99A	2x110VCT	.010	6.3/1A. 2.5VCT/1A.	3.25
CT-403	350VCT	.026 MA	5V/3A	2.75
CT-931	585VCT	.036	5V/3A. 6.3V/6A	4.25
CT-610	1250	.002 MA	2.5V/2.1A. 2.5V/1.75A	4.95
CT-137	350VCT	.026 MA	5V/3A	2.75
CT-866	330V	.055	6.3V/1.2. 6.3V/600 MA	1.75
CT-456	390VCT	30 MA	6.3V/1.5A. 5V/3A.	3.45
CT-160	800 VCT	100 MA	6.3V/1.2A. 5V/3A.	4.95
CT-319	660VCT	.085A	5V/2A, 6.3/7.5A, 6.3/3A	3.25
CT931	585VCT	86 MA	5V/3A. 6.3V/6A	4.95
CT-442	525VCT	75 MA	5V/2A. 10VCT/2A. 50V/200 MA	3.85

Filament Transformers—115V/50-60 cps input.

Item	Rating	Each
FTG-31	2.5V/2.5, 7V/7A (Tap @ 2.5V/2.5A), 16KV TEST	$9.95
FT-674	8.1V/1.5A	1.10
FT-157	4V/16A, 2.5V/1.75A	2.95
FT-101	6V/.25A	.79
FT-924	5.25V/21A, 2x7.75V/6.5A	17.95
FT-824	2x26V/2.5A, 16V/1A, 7.2V/7A, 6.4V/10A, 6.4V/2A	12.95
FT-463	6.3VCT/1A, 5VCT/3A, 5VCT/3A	5.49
FT-55-2	7.2V/21.5A, 6.5V/6.85A, 5V/6A, 5V/3A..	8.95
FT-986	16V @ 4.5A or 32V @ 4.5A	3.78
FT-38A	6.3/2.5A, 2x2.5V/7A	4.19
FT-A27	2.5V/2.5A, 7V/7A TAP 2.5V/2.5A 16KV TEST	18.95
FT-340	2x2.5V/3A, 7V/7A—23KV TEST	34.95
FT-638	6.3V/500A WELD	29.45
FT-364	6.3V/2A, 6.3V/4.5A	2.29

Plate Transformers—115V/50-60 cps input.

Item	Rating	Each
FT-919	1200-0-1200 200 MA	$8.95
FT-976	Auto: 120VCT/10 MA	.89
FT-31A	2x300V/5 MA	.79
FT-40A	4080VCT N.L. 5% to 18" Hvd. Wire L. 20 lbs	29.95
FT-833	4150V/400 MA	49.95
FT-403	Auto. 70V/1A	2.49
FT-160	1120VCT/770 MA, 390VCT/82 MA, 25 lbs.	34.95
FT-170	Auto: 156/146/137/128—.71A	3.29
FT-31A	2x300V/5 MA	.79
FT-976	120VCT/10 MA	.79
FT-12A	260VCT/1.2A	2.95
FT-614	4730VCT/500 MA 12 KV INS	29.95

KLYSTRON TRANSFORMER

PRI: 115V 60 CY.
SEC: 1050V/10MA, MINUS 625V/5MA, 26.3V/4.5, 2x2.5V/3A, 6.3V, 3A.
Stock No. CT-341. Only a few left at.... $22.45

115 V—400 CY XFMRS

Stock #	Ratings	Price
901699-5R1	2.77V @ 4.25A	$1.45
901698-5R1	900V/75MA, 100V/.04A	1.25
UX8855C	900VCT/.067A, 5V/3A	1.75
RA6405-1	800VCT/65 MA, 5VCT/3A	1.69
T-48852	700VCT/80 MA, 5V/1A, 6V/1.75A	4.25
352-990	2500V/15 MA, 5VCT, 125 MA	3.98
KS 9336	1100V/50MA TAPPED 625V 2.5V/5A	1.95
M-7474319	6.3V/2.7A, 6.3V/.66A, 6.3VCT/21A..	4.25
KS 9685	277V/4A, 6.9V, 1.25V/.02A	2.95
52C880	526VCT/50MA, 6.3VCT/2A, 5VCT/2A	1.75
22332	400VCT/35MA, 6.4V/2.5A, 6.4V/.15A	2.45
68GE31	1150-0-1150V	2.75
89G198	6VCT, .00006 KVA	1.75
382433-A	6.3V/9.1A, 6.3VCT/6.5A, 2.5V/3.8A, 2.5V/3.5A	4.85
KS 9445	592VCT/118MA, 6.3V/8.1A, 5V/2A.	5.95
KS 9685	6.4V/7.5A, 6.4V/3.8A, 6.4V/2.5A	4.79
78G180Q1	600 VCT/36 MA	2.45
M-7474318	2100V/.027A	4.95
95-G-45	2000V/.002A, 2000V/NL, 465V/6A, 44V/10A, 6.3V/23.5A, 6.3V/1.8A, 5V/9A, 2X2.5V/1.75A	17.95
TRANSTAT:	IN: 115V, 400 CY. OUT: 75-120V	12.95

FILTER CHOKES

Stock	Description	Price
CH-250	SWING. 2.5-24H/.4-.05A 10KV Test	$7.95
CH-8-19	SWING. 20H/5A-.025H/.5A .032 ohms DCR, 1KV TEST	3.95
CH-776	1.28 H/130 MA/75 ohms	2.25
CH-344	1.5 H/145 MA/1200V Test	2.15
CH-854	1 HY/80 MA	1.79
CH-43A	10 HY/15 MA—850 ohms DCR	1.75
CH-999	15 HY/15 MA—400 ohms DCR	1.95
CH-5211	6 H/80 MA—340 ohms DCR	2.45
CH3-581	2x.5H/400 MA	2.79
CH-188M	5 HY 200 MA	1.79
CH-488	10 HY .080A	1.79
CH-791	Dual 1.75-125 HY 100 MA	1.27
CH-86C	Dual .01-3.5 HY 950-75 MA	1.10
CH-981	15 HY .110A	1.59
CH-22-1	1 HY .100A	1.17
CH-779	.6 HY 490A	1.25
CH-25A	SW .09/.018 HY 3/.5A	9.95
CH-822	10000 HY 0 MA	2.75
CH-843	2.2 HY 80 MA	.95

All merchandise guaranteed. All prices F.O.B. N.Y.C. Send M. O. or Check. Only shipping charges sent C.O.D. Rated concerns send P. O.
All merchandise subject to prior sale and prices subject to change without notice.

COMMUNICATIONS EQUIPMENT CO.
131 Liberty St., New York, N. Y. Dept. E-3 Chas. Rosen Phone: Digby 9-4124

EQUIPMENT CO. — SONAR

PULSE EQUIPMENT

MIT. MOD. 3 HARD TUBE PULSER: Output Pulse Power 144 KW (12 KV at 12 Amp.) Duty Ratio: .001 max. Pulse duration: 5. 1.0, 2.0 microsec. Input voltage: 115 v 400 to 3400 cps. Uses: 1-715B, 4-826-B, 2-"T"s, 1-"3. New.....$110.00

APQ-13 PULSE MODULATOR. Pulse Width .5 to 1.1 Micro Sec. Rep. rate 624 to 1248 Pps. Pk. Pwr. out 35 KW Energy 0.018 Joules.....$49.00

TPS-3 PULSE MODULATOR. Pk. power 50 amp. 24 KW (1200 KW pk); pulse rate 200 PPS, 1.5 microsec. pulse line impedance 50 ohms. Circuit series charging version of DC Resonance type. Uses two 705-A's as rectifiers. 115 v. 400 cycle input. New with all tubes.....$49.50

APS-IC MODULATOR DECK. Complete, less tubes.....$75.00

PULSE NETWORKS

15A—1-400-50: 15 KV. "A" CKT. 1 microsec 400 PPS, 50 ohms Imp.....$22.50

G.E. #6E3-5-2000-50PZT, 6KV "E" circuit, 3 sections .5 microsecond, 2000 PPS 50 ohms impedance.....$6.50

G.E. #3E (3-54-810) (3-2.24-405) 50PZT: 3KV "E" CKT Dual Unit: Unit 1, 3 sections, .84 Microsec. 810 PPS, 50 ohms Imp.: Unit 2, 3 Sections, 2.24 microsec. 405 PPS, 50 ohms Imp.....$6.50

7.5E3-1-200-67P. 7.5 KV. "E" Circuit, 1 microsec 200 PPS, 67 ohms impedance. 3 sections.....$7.50

7.5E4-16-60, 67P, 7.5 KV. "E" Circuit, 4 sections 16 microsec, 60 PPS, 67 ohms impedance.....$15.00

7.5E3-3-200-67-P, 7.5 KV, "E" Circuit, 3 microsec, 200 PPS, 67 ohms imp. 3 sections.....$12.50

MULTI SECTION PULSE NETWORK:
ALL RATINGS 8KV Z=50 OHMS, "E" CKT.

Pulse Length μ Sec.	PRR	Sections
.25	1600	2
.50	800	
2.0	400	
5.20	200	
		4 + 4

Physical Size: 2" x 18 3/8" x 5 3/8".....$47.50

PULSE TRANSFORMERS

G.E.K.-2748.....$39.50

G.E.K.-2744-A. 11.5 KV High voltage. 3.2 KV Low Voltage @ 200 KW oper. (270 KW max.) 1 microsec. or 1/microsec. @ 600 PPS.....$39.50

W.E.-KS 9800 Input transformer. Winding ratio between terminals 3-5 and 1-2 is 1.1:1, and between terminals 6-7 and 1-2 is 2:1. Frequency range: 380-520 c.p.s. Permalloy core.....$6.00

W.E. #D169271 Hi Volt input pulse Transformer.....$27.50

G.E. K2450A. Will receive 15KV, 4 micro-second pulse on pri. secondary delivers 14KV. Peak power out 100KW O.F.....$34.50

G.E. K2748A. Pulse Input line to magnetron.....$36.00

Ray UX 7896—Pulse Output Pri. 5v, sec. 41v.....$7.50

Ray UX 8442—Pulse Inversion—40v + 40v.....$7.50

Ray UX 7361.....$5.00

PHILCO #352-7250, 352-7251.

UTAH #9262, 9332, 9278.

MICROWAVE TEST EQUIPMENT

X BAND POWER METER

Consists of thermistor mount and bridge, microammeter, rough attenuator. X-Band Waveguide thruout. For power measurements anywhere in the 9000 MC band.

BROADBAND TEST OSCILLATOR

Freq. coverage 50-5000 MC. By direct calibration and interpolation anti-backlash gear drive; compact, portable. Operates from any 115V source or battery source. New, with all tubes.....$425.00

TS 36A/AP	**I-158**	**TS 47/APR**	**TS 250/APN**
CW60-ABM	**I-222**	**TS 36/AP**	**TS 89**
LU-1	**I-185**	**TS 12 UNIT 2**	**I-203-A**
LU-3		**O. METER**	**TS 11/AP**
TS 139	**TS 268/U**	**TS 69/AP**	**TS 11/AP**
CS60-ABW	**TS 102/AP**	**TS 226**	**BC 438**

SEND FOR FURTHER INFORMATION AND PRICES

MICROWAVE ANTENNA EQUIPMENT

AS-31/APN-7: 10 cm. Polyrod in Lucite Ball. Type N Fitting. Coax Feed.....$27.50

3 CM ANTENNA WITH DISH 14". Cutler Feed horizontal and vertical scan with 3 V DC drive motor and drive mechanisms. Complete. New.....$125.00

Relay System Parabolic reflectors approx. range 2060 to 6000 Mc. Dimensions 4½" x 3". New.....$75.00

Dipole for above.....$12.00

TDY "JAN" Radar rotating antenna, 10 cm. 30 deg. beam, 115 V AC drive. New.....$150.00

10 CM Horn, Rectangular-to square-to circular RF assembly ending in horn, radiating circularly polarized beam. Waveguide input. Complete with flange.....$50.00

Parabolic Reel. Radiation pattern approx. 25 deg. in horizontal, 33 deg. in vertical planes.....$35.00

Cone Antenna. AS 125 APR, 1000-3200 mc. Stub supported, with type "N" connector.....$4.50

140-600mc Directional Antenna

140-310mc cone and 300-600 mc cone, each consisting of 2 end fed half wave conical sections with enclosed matching stub for reactance changes with changing frequency. New: complete with mast, guys, cables, carrying chest....$49.50

AN MPG-1 Antenna. Rotary feed type high speed scanner antenna assembly, including horn parabolic reflector. Less internal mechanisms. 10 deg. sector scan. Approx. 12'L x 4'W x 3'H. Unused.....$250.00
Gov't Cost—$4500.00

RADAR SETS

APS-2, Airborne, 10 CM, Major Units, New.

APS-4, Airborne, 3 CM, Compl.

APS-15, Airborne, 3 CM, Major Units, New.

SD-4, Submarine, 200 MC, Compl., New.

SE, Shipboard, 10 CM, Compl., New.

SF-1, Shipboard, 10 CM, Compl., New.

SJ-1, Submarine, 10 CM, Compl., Used.

SL-1, Shipboard, 10 CM, Compl., Used.

SN, Portable, 10 CM, Compl., Used.

SQ, Portable, 10 CM, Compl., Used.

SO-1, Shipboard, 10 CM, Compl., Used.

SQ-2, Portable, 10 CM, Assault.

SO-3, Shipboard, 10 CM, Compl., Used.

10 CM RESEARCH EQUIPMENT

COAXIAL WAVEMETER. W.E. Transmission type, using type "N" fittings. Calibrated between 3400-4500 MC.....$99.50

LHTR. LIGHTHOUSE ASSEMBLY, Part of HT39 APQ 5 & APQ 15. Receiver and Trans. Cavities w/zeros. Tr. Cavity and Type N CPLG. To Recvr. Uses 2C40, 2C43, 1B27, Tunable APX 2400-2700 MCS. Silver Plated.....$49.50

BEACON LIGHTHOUSE cavity 10 cm. Mfg. Bernard Ikos.....each $47.50

MAGNETRON TO WAVEGUIDE Coupler with 721A Duplexer Cavity, gold plated.....$45.00

SIGNAL GENERATOR, using 417A klystron, 2700-3300 mc. Output approx. 80 mw. 115 vac power supply. With tubes, new.....$425.00

REGULATED POWER SUPPLY for CL 446 type lighthouse tubes (3C40, etc.) 115 vac. 60 cycles. Panel Mounting. Less tubes.....$32.50

RT-39/APG-5 10 cm. lighthouse RF head c/o Xmtr.-Recvr.-TR cavity, compl. recvr. & 30 MC IF strip using 6AK5 (3C40, 3C45, 1B27 lineup) w/Tubes.....$12.50

721A TR BOX complete with tubes and tuning plungers.....$4.00

McNALLY KLYSTRON CAVITIES for 707B or 2K28. Three types available.....$35.00

TS 268 CRYSTAL CHECKER.....$12.50

F 29/SPR-2 FILTERS, type "N" input and output.....$4.50

WAVEGUIDE TO ⅞" RIGID COAX "DOORKNOB" ADAPTER CHOKE FLANGE SILVER PLATED BROAD BAND.....$32.50

AN/APR5A 10 cm antenna equipment consisting of two 10 cm waveguide sections, each polarized, 45 degrees.....per set, $75.00

POWER SPLITTER: 726 Klystron input dual "N" output.....$5.00

MAGNETRON COUPLING FOR TYPE 720 MAG. to 1¼" x ½" Waveguide.....$35.00

S BAND SIGNAL GENERATOR, complete with calibrated attenuator, W. E. coax. wavemeter, McNally Klystron Cavity. Regulated power supply operates from 115 V.A.C., 50-1200 Cycles. Manufactured by W. E.....$650.00

CAJ ECHO BOX. 10 CM. TUNABLE.....$22.50

⅞" RIGID COAX—⅜" I. C.

RIGHT ANGLE BEND, with flexible coax output pickup loop.....$8.00

SHORT RIGHT ANGLE BEND, with pressurizing nipple.....$3.00

RIGID COAX to flex connector.....$3.50

STUB-SUPPORTED RIGID COAX, gold plated 5' lengths. Per length.....$5.00

RT. ANGLES for above.....$2.50

RT. ANGLE BEND 18" L. OA......$3.50

FLEXIBLE SECTION, 15" L. Male to female.....$4.25

FLEX COAX SECT. Approx. 30 ft.....$16.50

⅞" RIGID COAX. BULKHEAD FEED-THRU.....$14.00

1.25 CM RESEARCH EQUIPMENT

Low Power Load.....$20.00

Waveguide Lengths, 2" to 6" long, gold plated with circular flanges and coupling nuts.....per inch, $2.25

APS-34 Rotating Joint.....$9.50

Right Angle Bend E or H Plane, specify combination of couplings desired.....$12.00

45° Bend E or H Plane, choke to cover.....$12.00

Mitered Elbow, cover to cover.....$4.00

TR-ATR-Section. Choke to cover.....$4.00

Flexible Section 1" choke to choke.....$5.00

"S" Curve Choke to cover.....$4.50

Adapter, round to square cover.....$5.00

Feedback to Parabola Horn with pressurized window.....$27.50

90° Twist.....$10.00

3 CM RESEARCH EQUIPMENT
1" x ½" Waveguide

1" x ½" waveguide in 5' lengths, UG 39 flange to UG40 cover....per length, $7.50

Rotating Joints supplied either with or without deck mounting. With UG40 flanges.....each, $17.50

2J42 Magnetron Pulse Modulator. 14kw max. rating 7kw min. Pulse voltage pulsed 5.5kv 6.5 Amp. .001 duty cycle, 2.5 μ sec pulse length max. filament 6.3V .6 Amp. Includes magnetron mtg. and blower. Requires 3C45 and 2-3B24. New.....$75.00

Bulkhead Feed-Thru Assembly.....$10.00

Pressure Gauge Section 15 lb. gauge and press nipple.....$10.00

Pressure Gauge, 15 lbs.....$2.50

Dual Oscillator-Beacon Mount. P/O APS 10 Radar for mounting two **TR1A/B** klystron with crystal mts, matching slugs, shields.....$42.50

Dual Oscillator, Mount. (Back to back) with crystal mount, tunable termination attenuating slugs.....$18.50

Directional Coupler. UG-40/U Take off 20 DB.....$7.50

2K25/723 AB Receiver local oscillator Klystron Mount, complete with crystal mount. Iris coupling and choke coupling to TR.....$22.50

TR-ATR Duplexer section for above.....$8.50

CU 419/APS 15 Directional Coupler 25 DB.....$25.00

723AB Mixer—Beacon dual Osc. Mnt. w/xtal holder.....$12.00

Waveguide Section 12" long choke to cover 45 deg. twist & 2¼" radius. 90 deg. bend.....$4.50

Twist 90 deg. 5" choke to cover w/brass nipple.....$6.50

Waveguide Sections 2½ ft. long silver plated with choke flange.....$5.75

Rotary joint choke to choke with deck mounting.....$17.50

3 cm. mitred elbow "E" plane unplated.....$12.00

UG 39 Flanges.....$ .85

UG 40 Chokes.....$1.00

90 degree elbows, "E" or "H" plane 2¼" radius.....$12.50

90 degree twist 6" long.....$8.00

45 degree twist.....$8.00

40KW X BAND Radar, complete as described and illustrated in **July 1951 PROC I.R.E.**

APS-4 Under Belly Assembly, less tubes.....$375.00

1¼" x ⅝" WAVEGUIDE

Mtred Elbow H Plane UG51-UG52.....$12.00

8" St. sect. choke to choke.....$3.50

CG 94B/APQ 13 12" Flex. Sect. 1¼" x ⅝" OD.....$10.00

X Band Wave GD. 1¼" x ⅝" O.D. 1/16" wall aluminum.....per ft., 75¢

Slug, Tuner Attenuator W.E. guide. Gold plated.....$6.50

Bi-Directional Coupler, Type "N". Takeoff 24 d.b. coupling.....$27.95

Bi-Directional Coupler, UG-52, Takeoff 25 d.b. coupling.....$24.95

Waveguide-to-Type "N" Adaptor, Broadband.....$22.50

VARISTORS

D-167176	$ .95
D-172155	$2.25
D-168687	$ .95
D-171812	$ .95
D-162356(308A)	$1.50

THERMISTORS

D-166226	$1.50
D-167332 (tube)	$1.50
D-167613 (button)	$1.50
D-164699 for MTG	
"X" band Guide.	$2.50

All merch. guar. Mail orders promptly filled. All prices, F.O.B. N.Y.C. Send M. O. or Chk. Only shipping chgs. sent C.O.D. Rated concerns send P. O.
All merchandise subject to prior sale and prices subject to change without notice.

COMMUNICATIONS EQUIPMENT CO.
131 Liberty St., New York, N. Y. MR. CHAS. ROSEN **Dept. E-3, Phone Main 4-8373**

NEW YORK'S RADIO TUBE EXCHANGE

TYPE	PRICE	TYPE	PRICE	TYPE	PRICE	TYPE	PRICE	TYPE	PRICE	TYPE	PRICE
OA2	$2.00	2J21	17.95	4J41	199.00	307A	4.95	722A	3.95	866A	1.79
OA3	1.50	2J22	17.95	C5B	3.95	310A	7.95	723A/B	17.95	869B	37.50
OB2	2.00	2J26	27.75	5BP1	6.95	311A	7.95	724A	4.95	869BX	35.00
OC3	1.25	2J27	29.95	5BP4	6.95	312A	3.95	724B	6.95	872A	3.95
OD3	1.50	2J31	29.95	5CP1	6.95	323A	25.00	725A	9.95	878	1.95
C1A	4.95	2J32	69.95	5D21	27.50	327A	3.95	726A	6.95	884	1.95
C1B	6.95	2J36	105.00	5JP1	27.50	328A	9.95	726B	56.00	885	1.75
1B21A	2.75	2J38	17.95	5JP2	19.50	350A	7.95	726C	69.00	889R	199.50
1B22	3.95	2J42	150.00	5JP4	27.50	350B	5.95	728AY	27.00	914	75.00
1B23	9.95	2J49	109.00	WE6A5	2.50	357A	20.00	730A	28.95	931A	6.95
1B24	17.95	2J50	69.50	6C21	29.50	368AS	6.95	801A	1.00	954	.35
1B26	2.95	2J61	75.00	C6A	3.95	371B	2.95	802	4.25	955	.55
1B27	19.50	2J62	75.00	C6J	10.95	385A	4.95	803	7.95	956	.69
1B32	4.10	2K25	37.50	7BP7	7.95	388A	2.95	804	13.50	957	.29
1B38	33.00	2K28	37.50	7DP4	10.00	393A	8.95	805	5.95	958A	.69
1B42	19.95	2K29	37.50	12AP4	55.00	394A	7.95	806	25.00	959	1.69
1B51	9.95	2K41	150.00	15E	2.95	MX408U	.75	807	1.69	991	.65
1B56	49.95	2K45	149.50	15R	.95	417A	27.95	808	3.50	E1148	.35
1B60	69.95	2V3G	2.10	NE16	.68	434A	19.95	810	11.00	1280	1.95
1N21	1.35	3B24	5.50	FG17	6.95	446A	1.95	811A	3.15	1611	1.95
1N21A	1.75	3B24W	7.50	RX21	3.95	450TH	45.00	813	8.95	1613	1.38
1N21B	4.25	EL3C	5.95	FG33	12.95	450TL	45.00	814	3.95	1616	2.95
1N22	1.75	3C24	1.95	35T	4.95	464A	9.95	815	3.50	1619	.89
1N23	2.00	3C31	5.95	45 Special	.35	471A	2.75	816	1.45	1622	2.75
1N23A	3.75	3DP1A	10.95	RK39	2.95	527	15.00	829	12.95	1624	2.00
1N23B	6.00	3E29	15.50	VT52	.25	WL530	3.50	829A	13.95	1625	.45
1N26	8.00	SN2	5.50	RK72	1.95	WL531	22.50	829B	15.95	1851	1.85
1N27	5.00	4A1	1.75	RK73	1.95	700A/D	25.00	830B	11.50	2050	1.85
1N43	2.50	4B26	10.95	100TH	9.00	701A	7.50	832	7.95	2051	1.80
1N48	1.00	4C27	25.00	FG105	19.00	703A	6.95	832A	9.95	8012	4.25
1S21	6.95	4C28	35.00	F123A	8.95	705A	3.95	833A	49.95	8013	2.95
2B22	4.95	4E27	17.50	203A	8.95	707A	17.95	834	7.95	8013A	5.95
2B26	3.75	4J25	199.00	211	.95	707B	27.00	836	4.95	8020	3.50
2C34	.35	4J26	199.00	217C	18.00	714AY	19.95	837	2.95	8025	6.95
2C40	20.00	4J27	199.00	242C	10.00	715A	7.95	838	6.95	9001	1.75
2C43	27.00	4J31	199.00	244A	12.95	715B	18.00	845	5.59	9002	1.50
2C44	.90	4J32	199.00	249C	4.95	715C	25.00	849	52.50	9003	1.75
2C46	20.00	4J33	199.90	250TL	19.95	717A	1.95	851	80.50	9004	1.75
2D21	1.75	4J37	199.00	274B	3.00	718AY/EY	48.50	860	4.95	9005	1.90
2E22	3.75	4J38	89.00	304TH	15.00	719A	29.50	861	39.50	9006	.35
2E30	2.75	4J39	199.00	304TL	14.50	721A	3.95				

Minimum Order $25.00

ATTENTION PURCHASING AGENTS AND BUSINESS MANAGERS

WE PURCHASE COMPLETE INVENTORIES AND ELECTRONIC PARTS AND TUBES FOR CASH.
CAN WE HELP YOU TO OBTAIN URGENTLY NEEDED ELECTRONIC MATERIALS?
OUR ORGANIZATION IS DEDICATED TO SERVE THE ELECTRONIC FIELD.
YOU CAN REACH US ON TWX NY1—3235

TEST EQUIPMENT

TSK1-SE
TVN3EV Bridge
RF4
APA10
TS10
TS12
TS15
APA28
TS33
TS34
TS34A
TS35
TS36
TS62
TS69
CY94
TS100
TS102
PE102
TS110
TS126
TS127
TS146
TS155
TS168
TS174
TS226
TS270
LZ Sets
BC1277
BC1287
WE 1-147
Hazeltine 1030
RADAR Sets
& Parts, APS 3, APS 4.

ATTENTION:

OIL COMPANY ENGINEERS, SHIP SUPPLIERS, USERS OF SHORAN

We have for immediate delivery, tested and guaranteed perfect, new

4C28

SPECIAL PRICE

$35.00

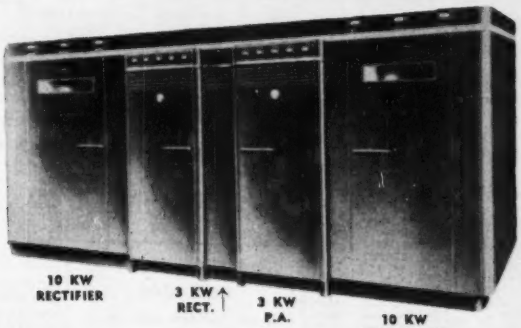
LIBERTY ELECTRONICS, INC.

PHONE WORTH 4-8262 — 135 LIBERTY ST., NEW YORK 6, N.Y.

— THE BEST IN ELECTRONIC SURPLUS —

NEW GE 1 KW, 3 KW, AND 10 KW–RF AMPLIFIERS!!

1 KW P.A.



10 KW RECTIFIER — 3 KW RECT. — 3 KW P.A. — 10 KW POWER AMP.

Above G.E. Transmitting Equipment of recent design, NOT WAR SURPLUS, all NEW and export cased—at tremendous reduction from original price! Available, in quantity: Type BF-1-A, 1 KW Power Amplifier and Power Supply; BF-2-A, 3 KW Power Amplifier with separate matching Rectifier-Power Supply; BF-3-A, 10 KW Power Amplifier with separate matching Rectifier-Power Supply. This equipment is designed for 88-108 MC FM Broadcasting application, beautifully engineered and constructed. (250 Watt FM Exciter or Driver NOT AVAILABLE) Conversion to lower frequencies (2 to 24 mc. or other frequencies) can be accomplished at very low cost. Our factory will be glad to quote on conversion to specified frequencies. All units designed for 208/230 volts, 50/60 cycles operation; 3 KW and 10 KW units require 3-phase. All incorporate internal blower systems for forced air-cooling, and use latest G.E. hi-efficiency tubes. Quantities sufficient to interest manufacturers—to convert for other applications. Ideal for FM Broadcasters, communication companies, Schools, Labs!

WRITE FOR MORE COMPLETE SPECIFICATIONS AND PRICES.

TEST EQPT.

BC-221, I-222-A Signal Generator, 100-156 MC, with crystal calibrator, for 115 V. 60 cycles AC.

TU-56, TU-57, BC-1236-A, and 78E Sig. Generators, TS-148, I-148, TS-143/CPM—1 Synchroscope. Others.

RADAR

SCR-545-A, Complete in Trailer Trucks, with or without 25KVA Gas-Engine Generator Unit.

Hundreds of radar components, plumbing, magnets, tubes, transformers, etc.

RECEIVERS

RBM, BBS, BC-1068 VHF, SCR-206 Direction Finders with Loops. Others.

CRV-46136, 100 to 1500 KC, part of DP-13 Radio Eqpt.

RT-8/ARN-1 Radio Receivers, New. **Model ZB-3, Aircraft Homing Adapters,** with plugs and accessories. New Eqpt.

MISCELLANEOUS

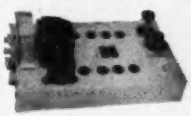
Wilcox 36A Rectifier-Power Supply, for 3 KW modulated transmitter. Designed for use with 4 or more 96C 3 KW Transmitters and 50A Modulator. New, Unused. **WRITE FOR PRICE.**

RADIOSONDE AN/AMQ-1, Meteorological Balloon transmitter with self-contained instruments. New Units, with slide-rule temperature evaluators and spare (sealed) humidity elements. Large quantity available. Receiving and Recording supplementary eqpt. also available. Type AN/FMQ-1. **WRITE FOR PRICES.**

32V. DC to 110V. AC KATO Converters, NEW, good to 200 watts.

BC-163 Radio Beacon Eqpt., designed for use with SCR-508 / 608 / 528 / 628 / 510 / 610 Transmitter-Receivers, 20 to 40 mc. Complete, export-packed, NEW equipment.

GENERAL ELECTRIC VOLTAGE REGULATOR & POWER SUPPLY MODEL 3GVD14B3



Output 750 volts up to 100 ma; complete power supply using 3 tubes, with selector switch for regulating or non-regulating. Operates from 110 V., 60 cycles AC. NEW units, less tubes, with operational data and diagram. **EACH** **$24.50**

ECLIPSE PIONEER TYPE C-14 MAGNESYN UNIT

Per W.E. Spec., KS-5899-L01 excitation 26 volts 400 C.P.S. current drawn 200 to 500 MA. Shaft locking arrangement overall dim. 2¼" dia. 2¾" long. .812" x 2.862" Mtg. centers. NEW Units.

Price, EACH **$7.50**

INDUSTRIAL CAPACITORS TYPE 18F75

Syncro—Capaciter

50-50-50 mfd., Delta connected, 90 V. AC, 60 cps. All NEW, packaged capacitors. For power-factor correction on 115 V. 3 phase AC, etc. Large quantity available.

EACH **$7.00**

TRANSMITTERS

T4/FRC, with Modulator
MD 1/FRC, and
PP-1/FRC, Power Supply.
RCA-ET 4332 and 4336.
TDE, TBK, 8010, 8003, for Ships.
ATD, for Aircraft.
BC-319, BC-604, BC-684, etc.
RCA-2.5 KW. Converted to R. F. Heater, 2.5 KW- output. Freq. range 10.7 to 14.4 mc. Consists of 2 cabinet units; Oscillator unit uses two 827R tubes forced air-cooling; Power supply uses six 872A rectifiers, with requisite meters and relay controls. Operates from 230 or 460 V., 50-60 cycles, 3 phase A.C. **PRICE AS IS**.....**$1,400.00**
TSI 500W. Simultaneous Radio Range and Telephone Transmitter. Frequency 200-400 KC. Mfd. for CAA by Federal Tel. Co.
BC-797, 50 Watt AM Transmitter. Freq. 110 to 130 MC, Xtal Control. Operation—110V. 60 cycles AC.
TDQ Transmitters, 100-156 MC, 45 watts AM output. Reconditioned to like new.
MANY OTHERS!

TRANS-RECEIVERS

SCR-509 & 510, SCR-511, SCR 609 & 610, SCR-522, LINK Model 1498, TCS with 12/24/230 DC and 110V, AC Power Supplies, SCR-508/528/608/628.

Jefferson Travis, Model 350-A, Transmitter-Receiver, 50 W. output, 1.5 to 12.0 mc, 5 channels operation—1 VFO and 4 X'tal—both transmitter and receiver. Power Supply operates from either 12/24/32/115 V.D.C., or 115 V. AC, 60 cycles. With Ant. Loading Coil unit, handset, key, & instruction book. Complete.

AUDIO SOUND

Beachmaster 250 W.; Western Elec. Model HLAS—500W.; RCA 25W. (12V.) Mobile; RCA MI-2817-E Amplifier, 1,000 Watts (2—500 Watt Channels); W.E. Speaker Units D-173246, (25-30 Watts) and D-173232A (50-60 Watts), considerable quantity available.

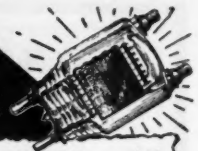
Immediate Delivery from Stock — **All Prices F.O.B. N.Y.C.** — **All Material Offered Subject to Prior Sale**

***Cable:* Telemarine, N. Y.**
***Tel.* LOngacre 4-4490-1**

TELEMARINE COMMUNICATIONS CO.

540 W. 27th St.
N. Y. 1, N. Y.

TUBES for: INDUSTRY COMMUNICATIONS RESEARCH



ALL NATIONALLY ADVERTISED BRANDS—IN STOCK! Thousands of satisfied customers have found there's a *difference* when you buy new, factory-guaranteed tubes from TERMINAL!

R.C.A. RADIOTRONS	
OA2	1.70
OA3/VR75	1.56
OA4G	1.70
OB2	1.88
OC3/VR105	1.56
OD3/VR150	1.56
1P21	50.00
1P22	14.75
1P29	2.95
1P37	2.85
1P39	1.75
1P40	1.95
1P41	2.80
2AP1-A	10.55
2A4G	1.88
2BP1	9.60
2BP11	11.00
2C21/1642	1.90
2C22	1.60
2C43	25.50
2D21	2.00
2D21W	3.15
2E24	4.65
2E26	3.85
2J50	192.00
2V3G	3.09
2X2A	2.56
3A4	1.20
3A5	1.95
3B28	8.85
3AP1-A	14.25
3BP1-A	16.50
3C33	21.25
3E22	8.30
3E29	20.25
3FP7A	23.00
3JP1	19.00
3KP1	14.50
3KP4	15.00
3KP11	16.50
3RP1	14.50
4B26/2000	12.20
4-65A	20.00
4-250A/5D22	41.25
4E27/8001	24.50
4X150A	48.00
4X500A	121.00
5BP1-A	22.50
5CP1-A	23.25
5CP7-A	27.25
5CP11-A	27.50
5CP12	27.00
5FP4-A	41.75
5FP7-A	30.25
5FP14	30.25
5R4-GY	1.85
5TP4	45.00
5UP1	17.75
5UP7	20.25
5UP11	22.00
5WP11	70.00
6AG7-Y	1.75
6AS6	3.65
6AS7G	4.53
6C24	60.00
6SJ7-Y	1.00
6SN7GTY	1.40
6V6-GTY	1.03
7BP7-A	48.50
7CP1	30.75
7CP4	33.00
7JP1	23.50
7MP7	39.50
7MP14	39.50
7QP4	39.50
7TP4	52.00
10BP4-A	23.00
10FP4-A	29.50
10KP7	61.75
10-Y	2.29
12A6	1.62
12DP7-A	72.50
12KP4-A	31.30
12LBGT	2.50
12LP4-A	26.25
12SP7	47.40
12SW7	1.10
12SX7GT	1.40
14CP4	26.25
14EP4	18.95
16ADP-7	55.00
16AP4-A	38.00
16GP4-A	30.00
16GP4-B	30.00
16RP4	28.00
16TP4	28.00
17BP4-A	27.20
17CP4	26.50
17GP4	26.50
19AP4-A	45.00
19AP4-B	45.00
20CP4	41.00
21AP4	42.50
26A6	3.10
26A7GT	5.95
26C6	2.10
26D6	2.85
99-Y	4.60
172	65.00
203-A	13.75
204-A	130.00
211	13.75
217-C	21.17
559	5.35
629	13.00
672-A	35.00
673	21.00
677	55.00
715-C	63.00
800	11.50
801-A	4.85
802	4.75
803	24.25
804	17.50
805	13.50
806	34.25
807	2.50
808	10.75
809	4.00
811-A	5.00
812-A	5.00
814	14.25
816	1.45
826	12.50
827-R	172.50
828	13.75
829-B	16.25
830-B	11.50
832-A	12.90
835	19.50
836	9.00
837	5.80
838	13.75
841	4.35
842	4.85
843	2.60
845	13.75
846	250.00
849	138.00
857-B	209.00
861	178.25
862-A	1322.00
866-A	2.10
868	2.50
872-A	8.20
874	3.10
1616	8.65
1623	4.05
1624	4.00
1625	2.65
1629	1.40
1631	3.10
1632	3.25
1633	1.95
1634	1.40
1635	2.15
1644	3.10
1654	4.55
1945	135.00
1947	9.75
1949	11.30
1950	7.80
2050	1.85
5527	49.90
5550	50.00
9002	2.50
9004	2.30
9005	3.45
9006	1.60

VICTOREEN (THYRODES)

1867/VG-10A	75.00
VG-10A Special	67.50
1868/VG-13	17.00
1885	7.50
1886	8.00
1887	8.00
1888	5.00
1B102	60.00
1B106	60.00
1B124	30.00
1B125	40.00
1B126	100.00

VICTOREEN (SUB-MIN.)

5799/VX-21	3.75
5800/VX-41A	12.50
5801/VX-33A	6.75
5802/VX-32B	6.75
5803	6.75
5828	6.75
5841	6.50

232-C	560.00
233	500.00
237-A	435.00
241-B	115.00
242-C	15.00
249-B	9.00
249-C	9.00
251-A	300.00
255-B	145.00
258-B	11.00
266-B	210.00
267-B	22.00
270-A	194.70
279-A	355.00
284-D	17.50
308-B	100.00
311-CH	19.00
315-A	38.60
319-A	22.00
321-A	38.60
322-A	50.00
342-A	582.00
343-A	370.00
343-AA	435.00
492	260.00
492-R	260.00
498	450.00
501-R	100.00
502	80.00
502-R	130.00
504-R	125.00
508	500.00
575-A	24.00
673	24.50
725-A	250.00
5619	390.00
5666	225.00
5667	302.50
8002	132.00
8002-R	160.00
AR-150	20.00
AGR-995O	25.00
AGR-9951	110.00
AX-9900	22.00
AX-9901	33.00
AX-9902	60.00
AX-9903	19.00
AX-9904	150.00
AX-9904-R	225.00
AX-9905	6.00
FG-105	48.00
HF-60	12.50
HF-100	15.00
HF-120	17.50
HF-125	25.00
HF-130	19.00
HF-140	17.50
HF-150	19.00
HF-175	20.00
HF-200	28.50
HF-201-A	28.50
HF-250	30.00
HF-300	35.00
HF-3000	400.00
ZB-120	17.50
ZB-3200	300.00

TUNG-SOL

5687	5.10
5881	2.95

SYLVANIA

OA5	4.40
OB3/VR90	1.65
3D24	7.50
6AN6	3.50
6D4	2.85
6SJ7WGT	2.45
6SL7WGT	3.00
7AK7	6.50
807W	12.85
1299	1.36
5642	1.29
5933	12.85

NYTRON

2E25A	5.50
2E30	2.45
3D21A	10.70
5514	4.95
5516	7.95
5812	3.10
HY75A	4.70
HY615	2.25

WESTINGHOUSE

KU-618	15.75
SR-53	10.50

TAYLOR

211-C	12.50
T-20	4.00
T-40	4.50
T-55	9.50
T-100	12.50
T-200	25.00
TT-17	7.00
TUF-20	5.50
TZ-20	4.00
TZ-40	4.50

RAYTHEON

IAE5	12.65
2C34/RK34	3.50
2E26	3.85
CK501AX	2.15
CK506AX	1.88
CK512AX	1.88
CK522AX	1.88
CK523AX	1.88
CK524AX	3.15
CK525AX	1.88
CK528AX	1.88
CK529AX	2.41
CK553AXA	1.85
CK556AX	3.45
CK569AX	2.50
CK570AX	6.75
CK605AX	7.50
CK608AX	2.41
CK619AX	6.80
CK5784	7.50
CK5998	7.50
RK-3824W	11.75
RK-6D22	55.00
RK-72	11.75
2051	1.90

EIMAC

2C39A	36.50
4-65A	20.00
4-125A	30.25
4-400A	60.50
4X100A	48.00
4X150A	48.00
4E27A/5-125B	35.75
25T	9.00
35T	10.50
35TG	11.00
100TH	18.25
100TL	18.25
250TH	33.00
250TL	33.00
450TH	77.00
1000T	137.50
KY21A	13.25

NEW TUBE OF THE MONTH!

RCA 6146

This new, small-beam power tube is a "natural" for amateur and mobile radio use up to 175 Mc. Combines higher frequency range of the 2E26 with the higher power capability of the 807.

4.90

TERMINAL RADIO CORP.

is exclusive distributor in New York for Victoreen radiation measuring equipment, counter tubes, subminiature electron tubes and Hi-Meg resistors. Write for complete VICTOREEN catalog.

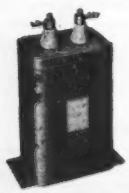
3950	6.50
6119	6.50
6143	6.50
VX-10	5.00
VXR-130	5.00

AMPEREX

4832	12.00
203-A	13.75
203-H	25.00
207	242.00
211-C	19.00
211-D	17.50
211-H	19.00
212-E	102.00
212-F	102.00
220-C	365.00
221-A	20.00
222-A	300.00
228-A	325.00
810	14.50
813	16.00
833-A	49.50
834	14.50
849-A	135.00
849-H	135.00
851	253.00
858	500.00
859	500.00
866-AX	2.50
869-B	132.00
880	510.00
889-A	210.50
891	223.00
891-R	362.00
892	223.00
892-R	362.00
893-A	630.00
893-AR	1150.00
5604	540.00

878	12.75
884	1.85
885	2.00
886	4.60
889R-A	295.00
902-A	12.50
905-A	65.25
908A	16.50
912	155.00
914-A	93.50
917	3.50
918	3.10
919	3.50
920	4.15
921	2.05
922	1.95
923	2.05
924	3.20
925	2.40
926	2.90
927	2.50
928	2.85
929	1.50
930	1.65
931-A	9.75
934	3.40
935	7.80
954	5.65
955	7.00
957	3.75
991	.75
1608	7.90
1610	2.50
5551	80.50
5553	121.00
5554	265.00
5556	190.00
5558	14.00
5563	47.00
5581	2.25
5582	2.65
5583	3.05
5584	3.95
5618	3.60
5652	6.55
5763	1.75
5819	55.00
5820	1200.00
5822	143.00
5826	1300.00
5879	1.75
5893	19.40
5915	1.20
5963	8.40
5964	1.50
6026	2.95
6146	4.90
8000	14.50
8003	14.00
8005	8.40
8008	8.40
8012-A	15.50
8013-A	10.30
8020	8.40
8025-A	11.30
9001	3.40

SPECIAL! OIL-FILLED CAPACITORS



These condensers are new and perfect, manufactured by radio industry's most famous names!

Capacity	D.C.W. Volts	Net Price
4 mfd.	10,000	49.50
10 mfd.	6,000	39.75
2 mfd.	5,000	9.95
4 mfd.	4,000	13.95
2 mfd.	4,000	8.95
4 mfd.	3,000	8.95
12 mfd.	1,000	6.95

SPECIAL! 2KW STEP-DOWN TRANSFORMERS

Westinghouse #2F127 2,000 watts EXPORT ADAPTER AUTOTRANSFORMERS. Reduce 230 volts to 115 volts, 50/60 cycles AC. Famous Westinghouse 2F127 autotransformers rated 230V to 115V 50 cycles 2,000 VA. Ideal for air conditioners, electric machinery, commercial refrigerators, transmitters, etc. Fully shielded. 9-foot heavy duty rubber cord and plug, two 115 volt outlet receptacles. Individually export-boxed. Net: 52 lbs.; Shipping weight: 63 lbs. Quantity limited. *Special,* **29.95**

Transformers for all radio applications in stock! We carry complete lines of U.T.C., KENYON, STANCOR, THORDARSON

GUARANTEE

All items sold by Terminal Radio Corp. are fully guaranteed. Prices subject to change without notice.

TERMINAL RADIO CORP.

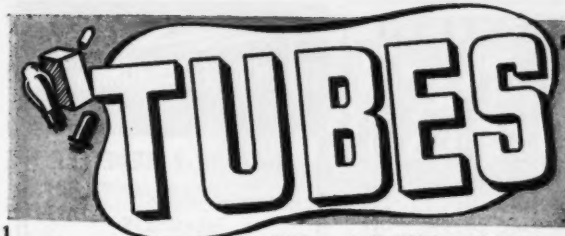
Distributors of Radio and Electronic Equipment

85 CORTLANDT STREET • NEW YORK 7, N. Y.

Phone: WOrth 4-3311 Cable Address: TERMRADIC

MINIMUM MAIL ORDER, $10

Prices are FOB, N.Y. Open account to rated firms.



RECEIVING

00A	$1.80
0A2	1.54
0A3/VR75	1.26
0A4G	1.15
0B2	1.84
0B3/VR90	1.25
0Y4	2.40
0Z4G	.74
1A	.72
1A3	.72
1A4P	1.29
1A5GT	.77
1A6	.84
1A7GT	.84
1AB5	.79
1AC5	1.10
1AD5	1.10
1B3GT	1.24
1B4P	1.14
1B5/25S	.94
1C7GT	1.24
1C8GT	.84
1C8	.72
1D5GP	.72
1D7G	.72
1D8GT	.72
1E5GT	.72
1E7GT	1.18
1F4	.72
1F5G	.72
1F6	.75
1F7G	.75
1G4GT	.72
1G5G	.75
1G6GT	.72
1H4G	.88
1H5GT	.74
1H6GT	1.04
1J3G	.75
1J6GT	.97
1L4	.72
1L6	1.33
1LA4	.88
1LB4	1.05
1LC5	.88
1LC6	.97
1LD5	.97
1LE3	.84
1LG5	.84
1LH4	.88
1LN5	.84
1N5GT	.88
1P5GT	.78
1Q5GT	.72
1Q6	1.10
1R4	.72
1R5	.94
1S4	.72
1S5	.84
1T4	.84
1T5GT	.72
1T6	1.20
1U4	.88
1U5	.88
1V	.71
1V2	.75
1V5	1.10
1W3	1.33
1W5	1.10
1X2	1.33
1X2A	1.33
2A3	.75
2A4G	.85
2A5	.45
2A6	.45
2A7	.45
2B7	.40
2E5	.45
2X2	.64
2X2A	1.50
2Z2	1.95
3A5	.89
3A8GT	2.40
3B7	.45
3C6/XXB	1.60
3D6	.45
3E6	1.33
3LF4	.94
3Q4	.78
3Q5GT	.84
3S4	.64
3V4	.89
5AZ4	.73
5R4GY	2.25
5R4GYW	3.50
5T4	1.94
5U4G	.72
5V4G	1.11
5W4GT	$ .80
5X4G	.88
5Y3GT	.62
5Y4GT	.72
5Z3	.88
5Z4	.88
6A3	1.24
6A4/LA	1.34
6A5G	1.95
6A6	.91
6A7	.88
6A8GT	1.04
6AB4	1.08
6AB5/6N5	1.33
6AB7/1853	1.04
6AC5GT	1.19
6AC7/4BZ	1.14
6AD7G	1.34
6AE8G	.88
6AF6G	.94
6AG5	.91
6AG7	1.34
6AH6	1.39
6AJ5	1.08
6AK5	1.49
6AK6	1.11
6AL3	.81
6AL7GT	1.33
6AQ5	.91
6AQ6	.86
6AQ8GT	1.20
6AR5	.78
6AS5	.99
6AT6	.72
6AU5GT	1.24
6AU6	.92
6AV5GT	1.33
6AW6	.72
6AW8	1.33
6AX5GT	.83
6B4G	1.60
6B7	.90
6B8G	.58
6BA6	.84
6BA7	1.14
6BC8	.97
6BC7	1.33
6BD5	1.60
6BD6	.99
6BE6	.88
6BF6	.78
6BG6G	1.18
6BH6	.96
6BJ6	.96
6BK4	.75
6BL7	1.48
6BN6	1.32
6BQ6GT	1.34
6BT6	.75
6BU8	.83
6BY5	1.33
6C4	.78
6C5GT	.78
6C6	.78
6C8G	.97
6CB6	.97
6CD6	2.34
6D6	.84
6D8	.88
6E5	1.10
6E6	1.33
6F7	1.95
6F5GT	.78
6F6	.94
6F6GT	.83
6F7	.88
6F8	.94
6G6	1.14
6H4GT	1.33
6H6GT	.78
6J5GT	.68
6J6	1.19
6J7GT	.81
6J8	1.60
6K5GT	.88
6K6GT	.78
6K7GT	.72
6K8GT	.94
6L5	.86
6L6G	1.74
6L6GA	1.74
6L7	.97
6N5	1.33
6N6	1.95
6N7GT	.88
6P5GT	1.20
6P7G	1.60
6Q6G	1.72
6Q7GT	1.00
6R7GT	$ .94
6R8	1.60
6S4	.88
6S7	.97
6S8GT	1.04
6SA7GT	.84
6SB7Y	1.20
6SC7	1.00
6SD7GT	.97
6SF5GT	.88
6SF7	.97
6SG7	.97
6SH7GT	.72
6SJ7GT	.88
6SK7GT	.88
6SL7GT	.97
6SN7GT	.97
6SQ7GT	.74
6SR7GT	.84
6SS7GT	1.04
6ST7	1.09
6SV7	1.24
6SZ7	1.10
6T7G	1.19
6T8	1.17
6U4	1.20
6U5	.94
6U6GT	.97
6U7G	.45
6V6GT	.88
6V6	1.54
6V6GT	.88
6V7G	.90
6W4GT	.84
6W5G	1.33
6W6GT	1.00
6W7G	1.04
6X4	.72
6X5	1.33
6X8GT	.74
6Y3G	1.95
6Y6G	.97
6Y7G	1.24
6Z4	.90
6Z7G	1.95
6ZY6G	.78
7A4	.78
7A5	.88
7A6	.84
7A7	.84
7A8	.88
7AD7	1.60
7AF7	.90
7AG7	1.04
7AH7	1.10
7AJ7	.90
7AQ7	1.10
7B4	.84
7B5	.84
7B6	.84
7B7	.84
7B8	.90
7C4	.78
7C5	.84
7C6	.84
7C7	.84
7C8	1.33
7E5	.74
7E6	.58
7E7	.88
7F7	.84
7F8	1.33
7G7	1.33
7H7	.84
7J7	1.33
7K7	1.19
7L7	.97
7N7	.84
7Q7	.82
7R7	.84
7S7	.97
7V7	.94
7W7	1.04
7X6	1.10
7X7	1.09
7Y4	.74
7Z4	.84
10	1.05
10Y	.88
12A	.64
12AB5	1.60
12A6	.72
12A6GT	1.45
12A7	1.04
12A8GT	.78
12AH7GT	1.26
12AL5	.92
12AT6	.72
12AT7	1.24
12AU6	.94
12AU7	1.14
12AV6	.72
12AV7	1.45
12AW6	1.33
12AX7	$1.20
12AY7	3.00
12B7	1.10
12BA6	.84
12BA7	1.10
12BD6	1.00
12BE6	.86
12BF6	.83
12BH7	1.20
12BJ6	.75
12BK6	.75
12BL6	.75
12BN6	1.45
12BT6	.75
12BU6	.75
12CL	.78
12CU	.78
12F5GT	.78
12H6	.90
12J5GT	.84
12J7GT	.81
12H7G	1.00
12K7GT	.78
12K8GT	.88
12Q7GT	.88
12S8GT	1.33
12SA7GT	.92
12SC7	.98
12SF5GT	.88
12SF7GT	.88
12SG7	.82
12SH7GT	.72
12SJ7GT	.78
12SK7GT	.94
12SL7GT	1.04
12SN7GT	.97
12SQ7GT	.83
12SR7GT	.84
12Z3	.84
14A5	.97
14A7	.77
14A5	.95
14A7	.84
14AF7	1.20
14B6	.94
14B8	1.10
14C5	1.33
14C7	1.20
14E6	1.10
14E7	1.33
14F7	.94
14F8	.94
14H7	.94
14J7	.94
14N7	.94
14Q7	.94
14R7	.94
14S7	1.33
14W7	1.33
14X7	1.33
14Y4	1.20
15	.35
18	.35
19	.35
19BG6G	2.34
19C8	1.60
19J6	1.60
19T8	1.45
20	.35
23	.35
24A	.74
25A6GT	1.60
25A7GT	3.70
25AC5GT	1.43
25B5	1.95
25B6G	1.33
25BQ6GT	1.60
25C6G	1.60
25L6	1.60
25L6GT	.84
25N6G	1.95
25S	1.60
25W4GT	1.00
25Y5	1.45
25Z5	.78
25Z6	1.10
25Z6GT	.75
26	.49
26BK6	.83
27	.39
28D7	.75
31	.84
32	.94
32L7GT	.88
33	.92
34	.88
35/5I	.82
35A5	.88
35B5	.88
35C5	.97
35L6GT	.84
35W4	.68
35Y5	.90
35Z3	.84
35Z4GT	.72
35Z5GT	.68
35Z6G	1.33
36	$ .78
37	.78
38	.50
39/44	.25
40	1.10
41	.74
42	.74
43	.74
45	.82
45Z3	.54
45Z5GT	.79
46	.81
47	.88
48	2.40
49	.94
50	2.48
50A5	.94
50B5	.94
50C5	.94
50C6G	1.45
50L6GT	.84
50X6	1.10
50Y6GT	.84
50Y7GT	1.00
50Z7G	.90
52	.95
53	.97
55	1.10
56	.84
57	.78
58	.84
59	.94
70A7GT	1.04
70L7GT	1.95
71A	.58
75	1.00
76	.45
77	.39
78	.78
79	1.33
80	.88
81	2.34
82	.88
83	1.14
83V	1.14
84	.84
85	.88
89	.25
99	1.60
99V	1.60
99X	1.80
117L7GT	1.34
117N7GT	1.34
117P7GT	1.34
117Z3	.74
117Z4GT	1.45
117Z6GT	1.33
FW-1000	1.60
XXD	1.20
XXFM	1.33

TRANSMITTING

1B22	$2.50
1B23	9.95
1B24	9.95
1B25A	4.95
1B38	4.95
1B27	19.50
1B29	2.50
1B35	3.50
1B38	30.00
1B42	4.95
1B60	24.50
1N21	.88
2AP1	11.95
2B22	1.29
2C4	1.12
2C21	.49
2C26A	.39
2C34	.78
2C40	8.75
2C43	12.95
2C44	4.95
2C51	4.50
2E22	1.19
2E24	4.95
2E25A	4.50
2E26	3.85
2E30	2.45
2J21A	9.75
2J22	9.95
2J26	28.50
2J27	26.50
2J28	29.50
2J30	29.50
2J31	29.50
2J32	29.50
2J33	29.50
2J34	29.50
2J37	12.50
2J49	37.50
2J50	22.00
2J54B	$37.50
2J55	87.50
2K23	45.00
2K25	39.50
2K28	35.00
2K29	22.50
2K33	3.75
3AP1	12.50
3B22Z	2.75
3B23	4.75
3B24	5.75
3B28	3.75
3B27	3.75
3B28	8.50
3BP1	8.50
3C24/24G	2.80
3C27B	8.50
3C31	3.25
3C45	17.50
3D21A	1.75
3DP1	4.75
3E29	14.50
3EP1	3.75
3FP7	3.75
3GP1	4.90
3HP7	3.75
4AP10	4.75
4B32	9.75
4C27	25.00
4J25	59.50
4-65A	29.00
4-65A	*14.21
4-250A	41.25
4-250A	*29.50
5AP1	3.50
5BP1	4.85
5AP4	4.95
5BP4	4.95
5CP1	4.95
5DP1A	9.95
5FP7	5.95
5FP14	9.95
5GP1	4.95
5HP1	4.95
5HP4	4.95
5J23	12.50
5J29	12.50
5JP1	24.50
5JP2	24.50
5JP5A	24.50
5LP1	19.50
5LP5	9.95
5NP1	3.50
6C4	8.50
6C21	22.50
7BP1	4.95
7BP7	7.50
7C23	72.00
7C25	90.00
7DP4	14.50
9C23	200.00
9GP7	14.00
9JP1	14.00
9LP7	14.00
10BP4	17.50
10CP4	19.50
12DP7	14.95
12FP7	4.25
12GP7	14.95
12HP7	14.95
12KP4	40.50
12TP4	37.50
12LP4	25.75
15E	1.15
15R	.75
35TG	11.00
35TG	*4.50
75TL	11.25
75TL	*6.50
100TH	18.25
100TH	*8.95
100TS	18.25
100TS	*1.95
114B	.75
203A	2.50
203A	8.50
211	.49
211A	.79
218	69.50
221A	1.50
227A	4.95
231A	1.15
247A	8.50
249B	3.50
249C	3.75
250R	22.00
250R	*9.95
250TH	33.00
250TH	*22.50
250TL	33.00
250TL	*19.50
252A	4.95
254	14.95
271A	4.95
274B	$1.85
275A	9.95
282A/B	4.25
283A	9.95
284B	7.50
286A	9.95
287A	2.75
298A	4.95
291A	4.95
293A	2.75
294A	4.95
301A	5.95
304TH	60.50
304TH	*19.50
304TL	60.50
304TL	*19.50
307A	5.00
310A	7.50
311A	6.75
322A	.75
328A	13.75
331A	12.50
350A	8.50
350B	4.75
354C/D	19.95
357A	39.50
367A	3.25
371A	1.25
371B	.75
374A	2.50
393A	5.95
398A	6.95
399A	2.50
399A	3.25
401A	1.95
417A	8.95
464A	12.50
527	12.50
531	4.85
532A	8.75
575A	13.50
700D	17.95
703A	6.95
705A	2.50
706BY	37.50
706UY	37.50
707B	14.95
708A	4.95
709A	3.75
710A	1.70
713A	1.40
714AY	6.75
715B	49.50
715C	29.50
717A	1.50
719A	28.00
721A	4.50
722A	2.75
723A/B	14.75
724A/B	3.75
725A	7.75
726A	6.75
726B	27.50
730A	12.50
800	1.75
801A	.28
803	4.25
805	4.25
807	1.75
808	4.85
809	1.45
810	9.95
811	2.95
811A	3.95
812	2.75
813	8.75
814	2.75
816	2.75
826	1.25
828	.75
829	12.00
829B	13.75
832	3.50
830B	3.75
832	9.95
832A	12.50
834	2.50
836	3.75
837	1.50
838	2.50
843	.29
845	4.50
849A/H	27.50
851	49.50
852	27.50
860	6.50
861	25.00
864	.29
865	1.25
866A	1.25
872A	2.40
874	1.25
876	.29
878	1.25
884	1.75
902Pi	11.50
905	3.75
918	1.50
923	.99
927	$1.25
931A	4.75
954	.35
955	.40
956	.40
957	.40
958A	.40
967	4.95
975A	12.95
991	.35
1603	8.00
1612	1.95
1613	1.50
1616	1.50
1619	.35
1620	4.75
1621	1.20
1623	2.00
1624	1.50
1625	.20
1626	.45
1629	.39
1630	.98
1631	.99
1632	.75
1634	.70
1636	3.00
1638	.50
1642	.65
1644	.99
1648	1.98
1649	1.25
1654	2.00
1655	1.25
1851	1.75
1960	.70
2050	1.25
2051	1.35
5810	1.00
5654	4.50
5670	5.50
7193	.45
8005	5.95
8011	1.75
8013A	2.75
8014A	29.50
8020	1.20
9001	1.25
9002	1.25
9003	1.75
9004	.50
9005	1.95
9006	.39
C9B	9.75
C6A	7.50
C6J	6.50
CK1008	.60
CK1006	.60
CK1090	.60
EF50	.75
EL3C	4.95
F123A	8.50
F660	49.50
FG17	4.95
FG27A	4.95
FG32	6.95
FG33	17.50
FG81A	2.50
FG104	25.00
FG105	19.50
FG166	47.50
FG172A	34.00
FG190	12.00
GL148	9.75
GL211	1.95
GL5J30	47.50
GL502A	1.98
GL530	47.50
GL559	3.00
HF100	3.95
HF210	14.95
HY69	1.50
HYE175B	.49
KU610	8.75
MY101	49.50
MX408U	.35
RI130	9.95
REL21	2.50
REL30	5.50
RK20A	9.50
RK25	4.48
RK29	3.95
RK48A	4.75
RK59	1.40
RK60/1641	1.50
RK72	.49
RK73	.49
RK21	2.75
TZ20	4.95
UX6853	.60
VR78	.60
VR91	1.25
VR102	1.60
VR105	1.25
VR150	1.09
VT127A	2.50
VU111	1.25
WL460	14.95
WL532A	2.50
WL562	49.50
WL616	35.00

ONE OF AMERICA'S GREAT RADIO STORES

Niagara RADIO SUPPLY CORP.

160 Greenwich Street, New York 6, N. Y.

Digby 9-1132-3-4

WRITE DEPT. E-3-2

Minimum order $5. 20% deposit with orders unless rated. F.O.B. N.Y.C. Prices subject to change without notice. * SURPLUS

BRAND NEW GUARANTEED
U. S. GOV'T. SURPLUS

POWER RHEOSTATS

Ohms	watt	ea.	Ohms	watt	ea.
.5	25	1.98	250	25	2.23
.5	50	2.81	250	50	2.53
.5	150	5.93	300	50	2.53
1	50	2.81	300	100	4.27
2	50	2.81	350	25	1.98
2	100	4.68	350	100	4.26
2	300	8.42	375	25	1.98
3	100	4.67	375	150	6.59
5	225	6.58	400	25	1.98
5x2	800	29.96	400	75	3.98
6	225	6.60	500	25	1.98
8	25	1.97	500	75	3.95
8	100	4.68	500	50	2.53
8	25	2.23	500	100	4.39
6	75	3.98	500	150	4.68
7	25	1.98	500	300	8.49
8	50	2.53	585	150	6.66
10	25	2.23	750	25	2.23
10	100	4.27	750	150	5.95
12	25	2.23	1000	25	1.98
12	50	2.53	1200	225	7.28
15	25	1.98	1250	50	2.66
15	75	3.98	1250	150	6.59
15	100	4.38	1250	25	2.53
20	50	2.53	1500	50	2.65
25	25	2.23	1500	150	6.24
50	25	1.98	2000	25	2.23
50	50	2.53	2000	50	2.53
50	25	1.98	2250	150	6.24
75	25	1.98	2500	150	6.24
75	75	3.98	2500	25	2.53
75	100	4.39	2500	100	4.68
80	800	12.46	3000	25	2.39
100	25	1.98	3000	100	4.68
100	50	2.53	5000	25	2.53
100	100	4.39	5000	50	2.85
125	25	2.23	7500	50	2.85
150	25	2.23	7500	100	5.31
175	26	2.53	10000	50	3.12
185	25	1.98	10000	100	5.51
200	25	1.98	15000	25	2.39
200	100	4.27	20000	150	8.43
225	50	2.53	Others		

SELECTOR SWITCHES

Pole	Pos.	Deck	Type	Each
1	11	1	Bak-n-shtg	.60
1	21	3	Bak-n-shtg	.89
2	2	1	Cer-shtg	.50
2	6	2	Bak-n shtg	.60
2	11	2	Cer-shtg	1.25
2	4	2	Bak-/shtg	.58
5	2	2	Cer-n shtg	.98
6	11	6	Bak-n shtg	1.95
10	5	10	Cer-shtg	2.25
16	2	4	Bak-n/shtg	1.35

Many other types in stock

"AN" CONNECTORS

Large Variety Available At Great Savings

Send your specs and let us quote

BIRTCHER TUBE CLAMPS

#926-A	FROM	#926-C5
#926-A1		#926-C10
#926-A14	**35c**	#926-C24
#926-B		#926-1
#926-B1		#930-12
#926-B7		#930-18
#926-B22		#930-19
#926-C		#930-21

MICROSWITCHES

MISCELLANEOUS

A. MOSSMAN LEVER SWITCHES

B. NOISE FILTERS

C. GLASS FERRULE RESISTORS

D. MALLORY SERIES 2000 PUSH SWITCHES

E. WE-I—PRECISION RESISTORS

See Dec. Issue for Complete Listings of above.

OIL CONDENSERS

Mfd.	Voltages Avail
.1	3-6-20K
.25	2-3-1½-4-5K
.5	600-1½-3K
1	600-1-1½-2-5-6K
2	400-600-1-1½-2-3-4K
4	600-700-1-1½ K
6	400-600-1½-3K
8	600
10	600-2½K
15	600-1K
30	90-vac. 3-ph
100	230-vac. 3-ph
2x4	500
2x5	600
4x5	600
4x8	600
3x10	90-vac. Special Prices on Request

BATHTUBS

Mfd.	Voltages Avail.
.033	400
.05	2-4-600
.1	2-4-1K
.15	600
.25	2-4-600
.35	400
.5	4-6-1K
.75	600
1	1-2-4-6-1K
2	1-600
4	50-160
8	300
25	25-50-75
40	25
80	25
100	15
200	13
300	6
2x.01	6-400
2x.02	6-1500
2x.045	600
.044x.055	600
2x.05	6-1500
.1x.05	200
1x.5	400x50
2x.1	4-600
2x.16	600
2x.2	600
2x.25	4-600
.5x.5	500
2x.5	4-600
1.5x.05	500
1.5x1	300
1.5x5	200
2x1	600
2x10	25
2x200	9
3x.001	600
3x.05	800
3x.1	4-600
3x.25	4-600
3x.5	100-600
015x.03x.045x.063x.12/.600	

Also available CHANNEL Types. Special Price on request.

TERMINAL BOARDS

5 terminal	80¢
8 terminal	1.67
12 terminal	2.49

SHOCKMOUNTS

100P-1	1 lb.	.15
100P-2	2 lb.	.15
100PR-2	2 lb.	.15
100P-3	3 lb.	.15
100P-6	6 lb.	.20
150P-4	4 lb.	.20
150PH-8	8 lb.	.45
100PL-1	1 lb.	.15
150P-7	7 lb.	.25
156P-6	6 lb.	.35
200PD-15	15 lb.	.59
200PHN-35	35 lb.	.75
204P-112	112 lb.	.96

HIGH POWER TR. MICA

G-1 TYPE		G-2 TYPE		G-2 TYPE	
.0001	5KV	.0001	10KV	.0011	20KV
.00015	5KV	.00015	10KV	.00124	15KV
.0002	6KV	.0002	10KV	.004	12KV
.0033	6KV	.0022	10KV	.025	1.5KV
.0047	6KV	.00247	12KV	.25	6KV
.005	5KV	.0033	10KV	.01	20KV
.01	4KV	.003	20KV	.00047	20KV
.022	2KV	.0004	20KV	.015	5KV
.04	1KV	.00045	15KV	.0012	20KV
.08	1.5KV	.0005	20KV	.0004	30KV
.09	1.5KV	.001	20KV	.001	30KV

TRANSMITTING MICAS

mfd.	wv	types.	mfd.	wv	type	ea.
.0001	600	4	.0015	600	4	.36
.0003	600	4	.0016	600	4	.42
.00035	600	4	.0022	600	4	.39
.00008	2500	9	.002	1200	4	.72
.0001	600	4	.0025	600	4	.39
.0001	2500	9	.003	600	4	.43
.00015	600	4	.004	600	4	.45
.0002	600	4	.005	1200	9	.99
.00025	600	4	.0067	600	4	.47
.0005	600	4	.29	2500	9	1.26
.0005	2500	4	.75	600	4	.54
.0005	2500	9	.77	600	4	.65
.0006	2500	9	.01	1200	9	1.41
.0007	600	4	.02	600	4	.92
.00075	600	4	.02	1250	9	2.12
.0008	600	4	.025	600	4	1.08
.0009	600	4	.03	300	4	.99
.001	600	4	.03	600	4	1.34
.001	1200	4	.043	600	4	1.75
.001	1200	9	.07	600	4	1.19

(Many other sizes in stock)

"UG" and "UHF" CONNECTORS

UG-9/U	UG-22/U	83-1H
UG/10U	UG-24/U	83-1J
UG-12/U	UG-29/U	83-1AP
UG-14/U	UG-27/U	831RTY
UG-15/U	UG-58/U	83-1SP
UG-16/U	UG-87/U	83-1R
UG-18/U	CW-123/U	83-1D
UG-19/U	UG-206/U	83-1SPN
UG-20/U	83-1AC	83-22R
UG-21/U	83-1F	CN 49181

PRICES ON REQUEST

TYPE "J" POTENTIOMETERS

TYPE "J" $1.50
TYPE "JL" $1.75 TYPE "JJ" $2.95

ohms	ohms	ohms	ohms	ohms
25*†	4000*†	75 K*†	500-500*†	130K-130K*
200*†	5000*†	80 K*†	600-600*†	150K-150K*†
400*†	6500*†	100 K*†	1500-1500*†	250K-250K*†
500*†	10 K*††	120 K*†	2000-500K*†	350K-5K*†
600*†	12K*†	125 K*†	2200-24K*†	350K-25K*†
750*†	15 K*††	250 K*	5K-45K*†	300K-300K*†
1000*††	20 K*††	500K*†	20K-700*†	350K-350K*
1400*†	25 K*††	2meg*†	25K-10K*†	800K-75K*
1500*††	30 K*††	1meg	35K-5000*†	2meg-2meg*†
2000*††	50 K*††	2meg*	50K-25K*†	4meg-4meg*†

TYPE "JJJ" $4.95

ohms	ohms	ohms
20K-200K-20K*†	750K-750K-750K*†	
45K-27K-2500*†	800K-800K-800K*†	
700K-700K-700K*†	1meg-1meg-1meg*†	

* 1/8" screwdriver slotted shafts.
† Knob type shaft.

JONES Connectors

P-101-1/4	P-504-DB	S-504-DB
P-101-3/8	P-506-DB	S-504-CE
P-306-AB	P-506-CE	
P-306-CCTL	P-510-CE	2-148-Y
P-306-FHTL	P-512-CE	3-140
P-310-CCT	S-101-D-MOD	15-140-3/4W
P-312-AB	S-102-AB	18-240
P-312-CCTL	S-304-CCT	18-240
P-315-CCT	S-306-CCT	3-141
P-315-CCE	S-306-CCTL	4-141-W
P-315-EB	S-308-AB	4-141-3/4W
P-318-CCE	S-308-CCTL	6-141
P-321-AB	S-315-EB	7-141-Y
P-324-AB	S-315-CCT	10-141-Y MEL
P-326-EB	S-318-AB	12-141-Y
P-324-CCT	S-321-CCE	15-141-Y
P-330-SB	S-330-AB	20-141-3/4W
P-402-SB	S-404-AB	MEL
P-406-AB	S-406-CCT	2-142-Y
P-406-LAB	S-408-CCT	4-142-Y
P-410-CCE	S-408-LAB	1-150
P-2410-SB	S-2408-SB	5-151
P-412-DB	S-410-AB	4-152
P-412-CCE	S-410-CCE	20-160-R
P-2412-SB	S-2412-CCE	20-161-AR
P-502-DP	S-502-DB	Others

Jones BARRIER STRIPS

ALEXANDER MOGULL COMPANY

WO rth 4-0865

Our new address **50 W. Broadway, N. Y. 7, N. Y.**

COLUMBIA ELECTRONICS LTD.

R-4/ARR-2 RECEIVER

34-58 mcs. Brand new. COMPLETE WITH RACK AND CONTROL BOX.

HEADSETS

HS-38 & HS-33 BRAND NEW

AN/CRT-3

EMERGENCY RADIO TRANSMITTER. T-74/CRT-3 DUAL FREQUENCY OPERATED TRANSMITTER. Operates on both 8280 kc. and 500 kc. Power output 2½ W. on 500 kc and 2 W. on 8280 Kc. BRAND NEW. COMPLETE WITH PARACHUTE, KITES, LAMP, BALLOON and GENERATOR.

SCR-615 PARTS

RC-184 IFF EQUIPMENT

Complete. Brand new.

MG-19A BRAND NEW

MODULATOR UNIT BC-1203-A
With Coupling Heads BC—1201 & BC-1202

APS-4 Complete Radar
Mark 16 Complete Radar
APS-6 Complete

RECEIVERS

APR-4 APR-5

TELEVISION CAMERA

350 line resolution. Easily converted to present RMA standards. Circuits available with camera. Complete, like new.

MK-20A/UP
Brand new. Individually boxed.

SCR-522 TEST SET

IE-19 COMPLETE

TEST EQUIPMENT
Complete Line!

DuMont 224-A Oscilloscope
1-77 Hickok Tube Checker
1-208 FM Signal Generator
RPC Model 644 Multimeter
Ferris Microvolter Mod. 18-C

IE-36 (New)	TS-100/AP
I-122	TS-111/CP
I-139 METER	TS-126
I-212	TS-127/U
I-222	TS-170/ARN-5
TS-3/AP	TS-175/UP
TS-108/APN	TS-182/UP
TS-19/APQ-5	TS-184A/AP
TS-24A/APR-2	TS-204/AP
TS-34/AP	TS-250/APN
TS-36/AP	UPM-1
TS-61/AP	(Complete)
TS-62/AP	WE 1 193
SL-1 Slotted Line Test Set	Range Calibrator 1-146

SEE COLUMBIA ELECTRONICS AD ON PAGE 468

All items subject to prior sale.

COLUMBIA ELECTRONICS LTD.
7460 N. VARNA AVENUE
NORTH HOLLYWOOD, CALIF.
Cable Address: COELECT

WESTON

Specialists in
Test Equipment

WESTON

MILITARY ELECTRONIC EQUIPMENT GUARANTEED TO COMPLY WITH *Original Specifications*

One of the largest reservoirs of test equipment in the United States may be found in our plant at Weston, Massachusetts. We actually have close to two thousand pieces of test equipment on hand. Most of these are laboratory quality including such famous brand names as General Radio, Ferris, Boonton, Measurements, Stoddard, Industrial Instruments, Leeds & Northrup, General Electric, Hewlett-Packard and so forth. In addition our stocks of military types, such as is listed below, remains the largest such inventory available. Our shop facilities and fixed test standards are second to none and permit in the hands of the most competent technicians the finest quality workmanship. We are, therefore, well equipped to service test equipment, design test equipment and to rebuild or modernize your test equipment.

TS-1ARR
TS-3A/AP
TS-8A/U
TS-10A/APN-1
TS-11/AP
TS-12
TS-13
TS-14
TS-15B/AP
TS-16/APN
TS-19
TS-23/AP
TS-24/APN-3
TS-27/TS
TS-32/TRC-1
TS-33/AP
TS-34/AP
TS-34A/AP
TS-35/AP
TS-36/AP
TS-46/AP
TS-47/APR
TS-51/APG-4

TS-56/AP
TS-60/U
TS-61/AP
TS-62/AP
TS-69/AP
TS-76/APM-3
TS-87/AP
TS-89/AP
TS-96/TPS-1
TS-98/AP
TS-100/AP
TS-101/AP
TS-102/AP
TS-108/AP
TS-110/AP
TS-111/GP
TS-117/GP
TS-118/AP
TS-125/AP
TS-127/U
TS-131/AP
TS-144/TRC-6
TS-153

TS-155A/AP
TS-170/ARN-5
TS-173/UR
TS-174/U
TS-175/U
TS-184/AP
TS-197/CPM-4
TS-203/AP
TS-204/AP
TS-205/AP
TS-220/TSM
TS-226A
TS-233/TPN-2
TS-251
TS-263
TS-286
TS-270/UP
TS-281/TRC-7
TS-301/U
TS-314/FSM-1
TS-323
TS-324/U
TS-389/U

TS-421/U
TS-487/U
I-56
I-95/A
I-106/A
I-122
I-126
I-130A
I-145
I-177
I-178
I-208/A
I-212
I-222/A
I-225
I-233
IE-21/A
IE-36
IF-12/C
IS-185
AN-PNS-1
BC-221(*)
BC-376

BC-638
BC-906/D
BC-949/A
BC-1060/A
BC-1066/A
BC-1201/A
BC-1203
BC-1236/A
BC-1255/A
BC-1287/A
BC-1277
BE-67
LAD
LAF

LAG
LM13
LU2
LU3
OAA-2
P4E
TAA-16EA
TS545E
TSX35E
TSX45E
TTS-4BR
TTX-10RH
TUN-9HU

OUR GUARANTEE

Each piece is laboratory tested to assure compliance with the original specifications.

Naturally what we sell has had to be purchased first. If you have test equipment not now in service won't you please help by advising us.

Cable: WESLAB

Tel. Boston: WE 5-4500

QUALITY

Weston Laboratories
Weston 93, Mass.

QUALITY

SURPLUS — NEW — GUARANTEED — SPECIAL METERS

SIGNAL CORPS & A.W.S. METERS

Sig. Corps Stock #	Sig. Corps Type #	A.W.S. Number	Description	Price
3F221		MR25W150DCMA	150 DCMA Gruen	3.95
3F311	IS-111		2.5 Amp. RF, Simpson	6.50
3F311	IS-111		2.5 Amp. RF, Westinghouse	7.50
3F311	IS-111		2.5 Ap. RF, McClintock	6.50
3F382	IS-182		6 Amp. RF, General Electric	5.50
3F891-6			4 KVDC (1 MA mvt.) Dejur	4.50
3F891-12			1.5 VAC Rect. type McClintock	6.00
3F901E5-2	MR35WO15DCMA		15 DCMA Simpson	6.00
3F905-17			5-0-5 DCMA Western Electric	4.95
3F920-1		MR35W200DCMA	200 DCMA Simpson	5.95
3F980			1000 DCMA Western Electric	4.95
3F980			800 DCMA Dejur	4.50
3F1003.3		MR35W003RFAA	3 Amp. RF, Westinghouse	7.50
3F1010-25		MR35W010RFAA	10 Amp. RF, Weston	9.50
3F7371	IS-171		8 MADC (0-3 Scale) Simpson	4.00
	IS-22		500 DCMA General Electric	3.95
	IS-99		8 Amp. RF, Simpson	5.50
		MR35W002DCMA	2 DCMA, Westinghouse	5.50
		MR35W300DCMA	300 DCMA, Gruen	4.95
		MR35W800DCMA	800 DCMA, General Electric	5.50
		MR34W001DCAA	1 Amp. DC, Westinghouse	6.00
		MR24W200DCAA	200 Amp. DC, (50 MV) Weston	5.50
		MR24W300DCAA	300 Amp. DC, (50 MV) G. E.	5.50
		MR24W500DCAA	500 Amp. DC, (50 MV) G. E.	5.50
		MR25W300DCVV	300 Volt, DC, Sun	7.00
		MR25W500DCVV	500 Volt, DC, Weston	9.50
		MR35W015ACVV	15 Volt, AC, Westinghouse	5.50
		MR25W008RLAA	8 Amp. RF, General Electric	5.50

N.A.F.-1091 METERS

C-30	R-17-A-5720	30 AMP	Weston
D-30	R-17-A-5740	30-0-30 AMP	G. E.
D-30	R-17-A-5740	30-0-30 AMP	Weston
C-60	R-17-A-5725	60 AMP	G. E.
C-60	R-17-A-5725	60 AMP	Weston
		50-0-50 AMP	Weston
D-60	R-17-A-5745	60-0-60 AMP	WH.
C-120	R-17-A-5730	120 AMP	Weston
C-120	R-17-A-5730	120 AMP	G. E.
D-120	R-17-A-5765	120-0-120 AMP	WH.
C-240	R-17-A-5735	240 AMP	Weston
A-30	R-17-V-770	30 AMP	Weston
A-60		60 AMP	G. E.
E-30	R-17-V-880	30 VOLT	WH.
D-3	R-17-A-5739	20-0-100 AMP	Hickok
D-2	R-17-A-5739	20-0-100 AMP	Weston
F-1	Spec. 94-32284	150 AMP	WH.
E-1	Spec. 94-32173-A	300 AMP	WH.

REPLACEMENT & SPARE "KS" METERS FOR WESTERN ELECTRIC TRANSMITTERS.

Only the following types are currently available! All other types previously listed have been sold out. Limited quantities. All units are 7½" round surface mounted Switchboard type meters, with black scales.

Range	Scale	Make	Model	Caption	Notes	W.E. KS #	Price
10 MA DC	0-12	G.E.	DR-2	Kilowatts R.F. Output	self contained	13745-L3	17.50
1 Amp D.C.	0-1	G.E.	DR-2	Amperes D.C. 1 K.W. Plate	self contained	13765-L3	17.50
2 Amp D.C.	0-2	G.E.	DR-2	Amperes D.C. 3 K.W. Plate	self contained	13675-L3	17.50
3 Amp D.C.	0-3	G.E.	DR-2	Amperes D.C. 10 K.W. Plate	self contained	13676-L3	17.50
300 MA. R.F.	300	G.E.	DR-2	Volts RF Transmission Line	int. vacuum couple	13605-L3	27.50
4 K.V. D.C.	0-4	G.E.	DR-2	Kilovolts DC 1 K.W. Plate	1 MA. tubular multip.	13769-L3	22.50
4 K.V. D.C.	0-4	Weston	252	Kilovolts DC Amplifier Plate	1 MA. tubular multip.	13606-L2	22.50
10 K.V. D.C.	0-10	G.E.	DR-2	Kilovolts DC 10 K.W. Plate	1 MA. tubular multip.	13638-L3	30.00
12.5 K.V. D.C.	0-12.5	G.E.	DR-2	Kilowatts DC Power Amp. Plate	1 MA. tubular multip.	13677-L3	32.50
300 Volts A.C.	300	G.E.	AR-2	Volts A.C. Power Supply	self contained	8302-L3	29.00
300 Volts A.C.	300	Weston	260	Volts, A.C. Power Supply	self contained	8302-L2	29.00

We specialize in electrical instruments. Over 75,000 meters in stock. Send for our latest circular showing our complete line of surplus-New-Guaranteed meters.

MARITIME SWITCHBOARD
INSTRUMENTS—ACCESSORIES
338 Canal St., N. Y. 13, N. Y.
Worth 4-8217

Orders accepted from rated concerns, public institutions and agencies on open account, others please send 25% deposit, balance C.O.D. or check with order. All prices FOB our warehouse, N.Y.C.

QUARTZ CRYSTALS

Made from the finest Brazilian quartz and will provide a high degree of activity and frequency stability. It is made to a frequency of F.01% in conventional amateur oscillator temperature coefficient is less than 3 cycles per megacycle per degree centigrade.

Price 1.15 each—25 for $25.00

Available in F-243 or CL16 in the following frequencies:—In K.C.

*2356 to 2358	6250	8026 to 8041
*2580 to 2581	6275 to 6350	8050
*2600 to 2674	6400	8051 to 8066
2800	6433 to 6475	8075
*3000 to 3078	6500 to 6600	8080 to 8083
3150	6625	8100
*3151 to 3200	6686 to 6783	8224 to 8888
3350	6815	9100 to 9300
*3415 to 3780	6830	9335 to 9399
3781 to 3799	6843 to 7000	9400 to 9499
3801 to 3890	7156 to 7299	9500
3912 to 3946	7312 to 7398	9501 to 9589
4000 to 4290	7400 to 7450	9608 to 9800
4300	7500 to 7597	10000 to 10018
4301 to 4366	7603 to 7618	10075
4400 to 4478	7625	12602 to 12699
4500 to 4595	7650	12700 to 12798
4600 to 4699	7675	12800 to 12899
4700 to 4799	7700	12902 to 12998
4800 to 4899	7701 to 7716	13001 to 13196
4900 to 4999	7725	13203 to 13299
5000 to 5092	7750	13302 to 13399
5100 to 5280	7759 to 7773	13400 to 13496
5317 to 5380	7775	13502 to 13598
5405 to 5450	7778 to 7794	13605 to 13698
5500 to 5558	7800	13702 to 13799
5600 to 5695	7825	13802 to 13897
5750 to 5760	7850	13905 to 13996
5800 to 5896	7875	14000 to 14099
5910 to 5965	7900	14102 to 14198
6000 to 6080	7925	14200 to 14298
6150 to 6162	7950	14300 to 14398
6175	7975	14400 to 14542
6200	8000	
6225	8025	

Type CR-1A/AR or XL11
Price .95 each 25 for $20.00

4800 to 4785	6500 to 6590	Type CRL-33
5000 to 5090	6600 to 6685	Price $1.15 ea.
5186	6815 to 6890	25 for $25.00
5120 to 5180	6905 to 6980	5000
5200 to 5230	7010 to 7080	6000
5250	7258 to 7330	8500
5270 to 5295	7440 to 7500	
5300 to 5396	7560	Type XL5
5410 to 5448	7600 to 7675	Crystals—
5748 to 5790	7700 to 7790	Price $1.35 ea.
5816 to 5891	7800 to 7880	920 to 1000
5910	7900	1300 to 1358
5923 to 6000	7910 to 7990	1616 to 1628
6018 to 6088	8000 to 8094	1705 to 2150
6138 to 6181	8115 to 8194	2300 to 2384
6200 to 6275	8213 to 8298	2410 to 2455
6300 to 6375	8300 to 8370	2561 to 2698
6370	8405 to 8490	2704 to 2787
6400	8500 to 8567	2901 to 2916
6401 to 6464	8638 to 8650	3105 to 3171
6470	11677	3232 to 3375
6475 to 6499		3410 to 3557

* Frequencies indicated above from and to, are to show that there are available crystals in small quantities in successive steps between these values, i.e., 14406 to 145463—available crystals are 14401, 14402, etc.

Where single frequency is shown, a quantity of 50 or more crystals are available in that frequency.

10 STATION INTERCOMMUNICATING SYSTEM

An unusual offering in a 10 station intercommunicating system for factory and interoffice communications.
Built for the U. S. Navy Type I-A for 115 volt 60 cycle operations with the following outstanding features:—
Operates individually, and separately, by push button control, 10 sub-stations.
Pilot light identification of each substation, on master unit.
Transformer coupled 6V6's in push pull to provide up to 10 watt output.
Amplification provided by 2-6BL's transformer controlled.
Rectification by 2-5Y3 tubes.
A high voltage test, power transformer providing filament and plate voltage to all six tubes.
Hayden 24 R.P.M. Motor, 10 VAC actuates the switch which blinks pilot light along each substation.
Jensen type NF 101 6½" high fidelity speaker, weatherproofed.
Tubes and audio transformers mounted, on a shock proof subchassis.
Entire unit mounted in a sturdy grey finished steel cabinet 15" x 11" x 10. Weight 48 lbs. net. Each packed in wooden crate.
This unit is priced at a fraction of original government cost.

Price $59.50 each

Substations for above consisting of a 4" 2.70Z magnet, Goodman, (British make) high fidelity speaker mounted in a handsome walnut, wood cabinet.

Price $6.50 each

We have substantially large quantities of desirable electronic materials at bargain prices listed in our catalogue #ED5.
To obtain a copy please write to:

EDLIE ELECTRONICS, Inc.

154 GREENWICH ST.
New York, N. Y.
Telephone DI 9-3143

OIL CONDENSERS

2 MFD. 5000 VDC $12.95

6 MFD. 600 VDC CP 70 BIFF 605K with Brackets, $2.75 each; by 100 lot $1.69 each

100 MFD. 1500 VDC $27.50

BATHTUB CONDENSERS CP53BIFF504K .5MFD—600V. . .$.84

Round 1 MFD. 1000 VDC screw Type 1 Lug 2¾" High.....50¢ ea. electrolytick condensers round

HAYDON SYNCHRONOUS MOTOR

110 V.A.C.
½ R.P.M.
3.6 Watts
$2.47 each

Haydon, 2.2 watt 1–120 RPM.....$1.68 complete with coin arrangement for 25¢ pc. .....$2.49 minimum order 5 pcs. on synchronous motor

MICA HIGH POWER Type G3 .0001 Mfd 25KV .....$48.00 ea. Type G2-50. .0001 mfd, .0002 mfd, .0005 mfd. 10KV.....$19.00

ATTENUATOR DAVEN TYPE T-894-2 7500/3900-2DBStep .....$4.25 Type TA-1000-2 7500/3900 Ohm..$5.25 ea.

Rheostat Type J 150 Ohm 50 Watt #5381 .....$2.15 each

RHEOSTAT Type K 100 Watt 25 Ohm $3.78

RHEOSTAT Type H 25 Watt 15 Ohm $1.65

LINE CORD AC manufactured by G.E. molded rubber plug, 12' lengths. $25 per 100 pcs.

RAYTHEON BENCH WELDPOWER #516 Miniature Model 115VAC less welding head. Has ability to Weld Difficult material. More information on request. Price $85.00

UG Connectors UG 352U..... $6.00 each
UG 9/U..... .95 each
3-15P..... .40 each

Relays, mfd. by Sigma 12 volts DC, S.P.D.T. size 2¼" x 1⅝".....$.77 each

RELAY G.E. Type CR2791-B109P36 SPDT 10000 Ohm coil .....$1.49 DPDT Type CR2791-B109U39 150 Ohm coil $1.95

PACKET SWITCHES made by A&H&H Type 80989 25 amp. size 2PDT and 3DPT $7.95 ea.

SELECTOR SWITCHES CENTRALAB Non shorting Type 1401 1 Pole 2-6 position 49¢ ea.

BUS FUSES
INDUSTRIAL-TUBES-RECEIVING

Relays and other Electronic material are available. Send us your inquiries.

No Risk to You
All Material Offered Brand New

LEONARD GREENE
381 Tremont St. Boston, Mass.
Phone HAncock 6-4794

SURPLUS EQUIPMENT

POWER RHEOSTATS

Standard Brands: 5 Ohms; 100 Watt; 4.48 amps 100 Ohms; 100 Watt; 1.0 amp.

Boxed, Brand New with Knob $2.50 each—or—$25.00 per Doz.

G. E. MOTOR AMPLIDYNE

Mod. 5AM45DB15. Input: 115 volts, single phase, 60 cycle, 4.5 amp. Output: 250 volts DC, .6 amps, 2450 RPM3.....$79.00 ea.

PIONEER TORQUE UNITS

TYPE 12604-3-A: Contains CK5 Motor coupled to output shaft through 125:1 gear reduction train. Output shaft coupled to autosyn follow-up (AY43). Ratio of output shaft to follow-up Autosyn is 15:1 $70.00 ea.

TYPE 12606-1-A: Same as 12604-3-A except it has a 30:1 ratio between output shaft and follow-up Autosyn....$70.00 ea.

TYPE 12602-1-A. Same as 12606-1-A except it has base mounting type cover for motor and gear train.....$70.00 ea.

ALNICO FIELD MOTORS

(Approx. size overall . . . 3⅜" x 1¼" diameter)

Delco-Type 5069230: 27.5 volts; DC; 145RPM $19.95 ea.

Delco-Type 5068820: 27.5 Volts; DC; 250 RPM .....$19.95 ea.

PIONEER AUTOSYNS

AY-1.....26 Volt—400 Cycle.....$4.95
AY-5.....26 Volt—400 Cycle.....$5.95
AY27D $25.50
AY6—26 Volt—400 cyc.....$4.95 ea.
AY30D—26 Volt—400 cyc.....$25.00 ea.
AY38D—26 Volt—400 cyc. shaft extends both ends .....$19.95 ea.
AY20—26 Volt—400 cyc.....$12.50 ea.

TACHOMETER INDICATOR SINGLE

Sensitive Type, Kollsman Mark V; Range 0-3500 RPM in 3¼ revolutions of the indicating pointer. $9.95 ea.

TACHOMETER GENERATOR

Pioneer Instrument Mark V, screw mount Used with Kollsman Mark V Indicator $25.50 ea.

Tachometer Indicator and Generator (above) .....Both $33.50

SMALL DC MOTORS

(Approx. size...4" long x 1¼" dia.)

General Electric-Type 5BA10AJ37: 27 volts, DC; .5 amps, 8 oz. inches torque; 250 RPM; shunt wound; 4 leads; reversible $12.50 ea.

G. E. Type 5BA10FJ216, 24 volts DC, .77 amp. 30 lbs. in. torque, 4 RPM...$15.00 ea.
General Electric-Type 5BA10AJ53C: 27 Volts, DC; .65 amp; 14 oz. inches torque; 145 RPM; shunt wound; 4 leads; reversible $12.50 ea.

SENSITIVE ALTIMETERS

Pioneer Part #1556-2K-A Sensitive altimetres. 0-35,000 ft. range . . . calibrated in 100's of feet. Barometric setting adjustment. No hook-up required. $12.95 ea.

PIONEER GYRO FLUX GATE AMPLIFIER

Type 12076-1-A, complete with tubes $27.50 ea.

PIONEER TORQUE UNIT AMPLIFIER

Type 12077-1-A. A single tube amplifier designed for autosyn take off signal. Contains magnetic amplifier assembly. With tube .....$24.50 ea.

SERVO MOTOR 10047-2-A: 2 Phase; 400 Cycle; with 40-1 Reduction Gear $10.00 ea.

BLACK LIGHT KITS

Ultra-Violet Fluorescence

Now . . . build your own black light lamp equipment at a new low cost with these easy - to - assemble components. Kit contains: Ultra-Violet tube brackets, ballast, starter, wire, plug and wiring diagram.
4-Watt Kit—(6⅛" tube).....$3.00
8-Watt Kit—(12" tube).....$4.00

SYNCHRONOUS SELSYNS

110 volt, 60 cycle, brass cased, approx. 4" dia. x 6" long. Mfg. by Delhi and Bendix.

Quantities Available

REPEATERS .....$15.00 ea.
TRANSMITTERS .....$15.00 ea.

400 CYCLE MOTORS

AIRESEARCH: 115V; 400 CPS; Single phase; 6500 RPM; 1.4 amp; Torque 4.8 in. oz.; HP .03.....$10.00 ea.
EASTERN AIR DEVICES TYPE JM6B: 200 VAC; 1 amp; 3 phase; 400 cycles; 6000 RPM .....$12.50 ea.
EASTERN AIR DEVICES, TYPE J31B: 115 V, 400-1200 Cycle, Single Phase. $12.50 ea.
PIONEER, CK-2, 400 cycle 2-phase, 115 volt .....$20.00 ea.

SYNCHROS

1F Special Repeater (115V-400 Cycle) $15.00 ea.
2JIF3 Generator (115V-400 cyc)..$7.50 ea.
5CT Control Transformer; 90-90 Volt; 60 Cyc. .....$50.00 ea.
5F Motor (115/90 volt—60 cyc.)...$60.00 ea.
5G Generator (115/90 volt—60 cyc.) .....$50.00 ea.
5SDG Differential Generator (90/90 volts —400 cyc.) .....$30.00 ea.
5DG Differential Generator 90/90 volts 60 cycle .....$50.00 ea.
TRANSMITTER, BENDIX C-78248: 115 Volt, 60 Cycle.....$25.00 ea.
REPEATER, BENDIX C-78410: 115 Volt, 60 Cycle .....$37.50 ea.

INVERTERS

PE 218 LELAND ELECTRIC
Output: 115 VAC; Single Phase; PF 90; 380/500 cycle; 1500 VA. **INPUT:** 26-28 VDC; 92 amps; 6000 RPM; Exc. Volts 27.5 **BRAND NEW** .....$39.95 ea.

MG 153 HOLTZER-CABOT
Input: 24 V. DC, 52 amps: Output. 115 volts—400 cycles, 3-phase, 750 VA, and 26 Volt—400 cycles, 250 VA. Voltage and frequency regulated .....$95.00 ea.

12116-2-A PIONEER
Output: 115 VAC; 400 cyc; single phase; 43 amp. **Input:** 24 VDC; 5 amp. $90.00 ea.

10563 LELAND ELECTRIC
Output: 115 VAC; 400 cycle; 3-Phase; 115 VA; 75 PF. **Input:** 28.5 VDC; 12 amp. .....$80.00 ea.

10486 LELAND ELECTRIC
Output: 115 VAC; 400 Cycle; 3-Phase; 175 VA; 80 PF. **Input:** 27.5 DC; 12.5 amp; Cont. duty .....$90.00 ea.

METERS

AMMETER: DC; 2" 100-0-100, complete with external shunt.....$5.95 ea.
AC Volt, Westinghouse, Type NA-35—2-inch round. F.S.-10 MA.....$6.95 ea.
FREQUENCY, 57-63 cycles per second, 125 volts, mfg. Aero mod. 7007. 3-inch round $8.95 ea.

MICROPOSITIONER

Barber Colman AYLZ 2133-1 Polarized D.C. Relay: Double Coil Differential sensitive; Alnico P.M. Polarized field. 24V contacts; .5 amps; 28 V. Used for remote positioning, synchronizing, control, etc. $12.50 ea.

PLEASE ENCLOSE FULL AMOUNT WITH ORDER

EQUIPMENT FULLY GUARANTEED

ALL PRICES F.O.B. PASADENA UNLESS OTHERWISE SPECIFIED

C and H Sales Company
BOX 356-E EAST PASADENA STATION • PASADENA 8, CALIFORNIA

WHOLESALE ONLY

ELECTRONIC COMPONENTS
AIRCRAFT EQUIPMENT
HYDRAULICS

RADIO & ELECTRONIC SURPLUS
13933-9 Brush St. Detroit 3, Mich.
Phone Townsend 8-3403

BRAND NEW STANDARD BRAND TUBES

OA2	1.45	2J26	24.50	4J42/700A	24.95	205B	3.95	703A	5.75	813	8.50	956	.69	9006	.29
OA3/VR75	1.47	2J27	24.50	5C30/C5B	3.75	211	1.75	704A	.95	814	3.75	957	.45	C5B	3.75
OB2	1.49	2J30	69.50	C6A	5.75	217C	8.75	705A	2.75	815	2.89	958A	.59	C6A	5.75
OC3/VR105	1.25	2J31	24.50	6AK5	1.35	250TH	20.95	707AY-GY	44.50	828	11.95	CK1005	.75		
OD3/VR150	.89	2J32	37.50	6C8G	.79	250TL	18.95	707A	9.95	829	10.95	E1148	.33	CATHODE RAY TUBES	
C1A	9.75	3J33	37.50	6K7G	.59	257B	14.95	707B	17.25	829B	14.95	1608	4.95		
1B22	6.95	2J36	89.50	7C4	.69	285A	10.95	710A/8011	.75	830B	3.25	1616	.89	3CP1/S1	1.95
1B26	2.75	2J40	37.50	7E5	.89	286A	18.95	713A	.98	832A	9.50	1619	.75	3DP1	4.75
1B27	18.75	2J61	47.50	7E6	.79	304TH	10.95	714AY	5.75	833A	48.75	1624	1.49	3FP7	1.85
1B29	4.75	2J62	47.50	10Y	.75	304TL	10.95	715A	5.95	836	4.75	1625	.40	4AP10	4.50
1B36	14.75	2K25/723AB		12A6	.79	307A	3.95	715B	9.50	837	2.49	1626	.40	5AP1	3.49
1B56	34.95		29.25	24G	1.75	310A	6.50	715C	24.10	838	3.95	1629	.35	5FP7	3.95
EL1C	2.69	2V3G	.98	25AC5	1.19	316A	1.39	721A	4.95	843	.25	1636	2.95	7BP5	18.95
1D8GA	.79	2X2	.59	RK34	.59	329A	8.95	722A	2.39	846	49.95	1642	.98	10BP4	17.95
1L4GT	.65	3B7/1291	.59	45 Spec/VT5	2.89	331A	8.95	723AB	17.95	851	48.75	1851	1.69	12LP4	20.95
1R4/1294	.89	3B22	2.69	EF50	.89	353A	4.95	724B	3.25	860	6.50	2051	1.09	12LP4A	22.25
1T4	.69	3B24	5.25	CRP72	1.25	371B	.89	725A	6.25	861	23.25	7193	.35	14BP4	26.50
2C21/1642	.65	3B26	3.50	FG17	5.95	388A	1.49	730A	20.95	864	.75	8001	14.95	16DP4A	34.00
2C22/7193	.30	3C24	1.75	RK72	1.25	417A	19.95	800	1.95	865	1.25	8011	.75	16RP4	35.00
2C26	.19	3C28	4.95	CRP73	1.25	450TH	44.50	801A	.75	866A	1.35	8012	2.75	17BP4A	35.00
2C26A	.39	3D6/1299	.59	RK73	1.25	530	16.95	803	4.95	869B	39.50	8013A	4.75	19AP4A	61.25
2C34/RK34	.59	3D22	4.75	REL5	75.00	531	6.75	805	4.95	872A	3.95	8020	1.25	19AP4B	61.25
2C40	9.95	3E29	13.95	FG81A	3.50	533	75.00	807	1.60	874	1.25	8025A	7.95	20CP4	49.95
2C44	1.00	3Q4	.69	VT90	.98	559	3.95	808	2.95	876	.59	9001	1.50		
2E22	2.95	4B28	4.45	VT98	75.00	HY615	.22	809	2.39	879	1.43	9002	1.25	TUNGAR BULBS	
2E24	4.85	4E27/2578	14.95	100TH	7.95	700A	24.95	810	12.75	931A	5.95	9003	1.75		
2E26	3.49	4J22	139.50	HY1148	.75	701A	4.95	811	3.25	954	.35	9004	.75	6 Amp. Rectigon	
2J22	7.50	4J26	159.75	VT127	2.50	702A	3.19	812	3.25	955	.45	9005	1.75	Westinghouse	4.75

MARITIME INTERNATIONAL COMPANY

11 State Street, New York 4, N. Y. Cable Address "Foxcroft" Phones: DIgby 4-3192-3

CONDENSERS

10 mfd.—1000 V $4.55
10 mfd.— 600 V $2.50
8 mfd.—1000 V $2.39

Dual 4 mfd. oil cond. herm. sealed and packed. Case of 10 . . . . . $2.10 ea.; 100 . . . . . $1.85

7 mfd.—600 V $1.45

Small, high quality oil cond. measuring 2½" x 3¾" x 1¾" complete with brackets.

6 mfd.—150 V . . . . . $ .25

Three term. dual 3 mfd. oil cond. complete with brackets, measuring 4¼" x 1¾" x 1". Ideal for audio crossover networks.

OIL CONDENSER SPECIAL
10 mfd.—600 v . . . . $ .89

Three term. bat. mntg. channel type. Dims. 3¾" x 2½" x 2". Two 5 mfd. sections rated 400 V at 72 deg "C", 1800 V test. Meets commercial specs. for 600 V. operation up to 40 degs "C". Ideal for filter or power factor application. Repeat sales prove this rugged high quality condenser to be of outstanding value. Carton of 24, weight 42 lbs. Large quc. available $ .79

1mfd.—25KV
1mfd.—15KV
.5mfd.—15KV
} Quotation on Request

16 mfd.—600 V $1.75

Dual 8 mfd. herm. sealed and packed. Type PT-SC-11 measuring 3¾" x 2⅛" x 2⅛". Stud mtg. centers 2". Plugs into standard four prong socket. Quantity discount.

6 mfd.—600 V $1.55
CP70BIFF605K Cbkts

See Jan. Electronics

For other conds, SWS

relays, tubes, mica & silvermica conds. Large quantities of trans. mica conds., "J" pots; bathtub & channel conds.

Monmouth Radio Laboratories, Art Hankins, Prop.

Box 159 *Long Branch 6-5792* Oakhurst, N.J.

Modification, Development & Production of Radar Equipment. Radar sets SCR-717, SCR-720, APS-3, APS-4, APS-13, and APS-15 available. Micro-wave test equipment for all frequencies. Our personnel and facilities guarantee performance and service. Your inquiries are solicited.

Tel.
Terhune 5-2765, 6

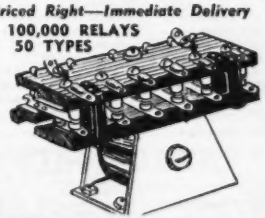
LERU LABORATORIES INC.

Black Oak Ridge Rd., Wayne, N. J.
Mailing Add.: RD 4, Paterson, N. J.

Priced Right—Immediate Delivery

EXAMPLE

100,000 RELAYS
50 TYPES



SIX-POLE DOUBLE THROW ALLIED #BN-18D-39 has 10 AMPERE CONTACTS 2800 ohm coil operates on 30 mills DC.....$6.95

115 VOLT AC RELAYS

GUARDIAN #110 A.C. SERIES—D.P.D.T. & S.P. N.O. 5 amp. contacts.....$1.95
STRUTHERS-DUNN D.P.D.T. ¼" contacts. Micalex base and crossarm.....$3.95
ADVANCE SERIES 1000 ¼" Silver D.P.D.T. contacts. Ceramic insulation.....$3.95

115 VOLT DC RELAYS

POTTER & BRUMFIELD #MR 7D—Double Pole N.O. 10 amp. contacts. 6000 ohm coil.....$2.95
GENERAL ELECTRIC #CR 2791-B109P36-S.P.D.T. double break contacts rated 3 amps. 10,000 ohm coil operates on 8 mills.....$1.95
ADVANCE SERIES 2000 ¼" Silver D.P.D.T. contacts. 4200 ohm coil and ceramic insulation..$3.95

LOW VOLTAGE DC RELAYS

ALLIED #BO 635 D.P.D.T. 15 amp. contacts. 24v. d.c. 220 ohm coil.....$2.50
MINIATURE—4 POLE D.T. contacts. 1¼" overall. 280 ohm coil. 24 V.D.C.....$2.95

LOW VOLTAGE AC RELAYS

POTTER & BRUMFIELD #MR7A—Double Pole N.O. 10 amp. contacts. 6 volt AC coil.....$1.95
GUARDIAN #110 A.C. Series—Double Pole N.C. & S.P.N.O. 5 amp. cts. 48 volt A.C. coil.....$1.95

RADIO DEVELOPMENT & SALES CO
323 Atlantic Ave., Brooklyn 2, N. Y. ULster 5-0488

The

"KELLOGG DEHYDRATOR"

An all purpose self-reactivating dehydrating unit. To be used for removing moisture from gases. Numerous applications in the fields of Physics, Electronics and Chemistry. Dual insulated tanks with thermostatically controlled heating elements. Complete with 20 lbs. of Silica gel., heating elements, shut-off and safety valves. **$62.50**

F.O.B. N. Y.

INTERSTATE Appliance Co., Inc.
Dept. KD 600 Broadway NEW YORK 12, N. Y.

TUBE REBUILDING
Large Transmitting and Power types
Economical • Guaranteed
FREELAND PRODUCTS CO.
700 DRYADES ST., N. O., LA.

GLASS TUBING
PYREX - NONEX - URANIUM
BULBS & CYLINDERS
WRITE FOR FREE MONTHLY LIST
HOUDE SUPPLY COMPANY
PHONE KEYPORT 7-1286
M. R. #1 Box 86X Keyport, N. J.

FOR SALE

PLATE TRANSFORMERS

Several hundred new 10 K.W. Amertran oil cooled plate transformers 115 v. 60 cy., 1 phase primary, 17,600 volts, .5 amp secondary. Can be furnished center tapped or two wire 8800 volts, 1.0 amps. Priced $75.00 each f.o.b. Los Angeles. Special Quantity discounts available.

EPCO
1527 E. 7th St., Los Angeles 21, Calif.

SAVE ON TUBES — BRAND NEW TUBES — GUARANTEED TUBES

0A2	$1.25	2B7	.79	3C33	12.50	6AG7	1.39	25L6GT	.69	35SA	12.50	726A	5.90	1807	.89
0B2	1.39	2C21/1642	.69	3D6/1299	.59	6ZJ5	2.49	FG-27A	6.95	371B	.75	726B	39.50	1613	.94
0B3/VR90	1.19	2C22/7193	.29	3DP1	3.95	6AK5	1.45	FG-32	12.50	374B	3.95	730A	19.95	1614	2.10
0C3/VR105	1.25	2C26A	.39	3E29	12.95	6AK6	1.10	32L7GT	.69	393A	7.95	803	3.75	1616	.98
0D3/VR150	.95	2C39	29.50	3Q4	.69	6AN5	5.50	33/44	.39	396A	4.95	807	1.50	1619	.39
01A	.69	2C40	8.50	3Q5GT	1.15	6AS6	1.50	T-40	3.00	417A	8.50	814	2.95	1624	1.75
VS-2	8.50	2C43	24.50	3S4	.89	6AS7G	4.50	RK47	4.95	446A	1.19	889	2.95	1625	.39
1A3	.98	2C44	1.19	4B24	7.50	6B8	1.00	RK48A	8.95	446B	5.00	810	9.50	1626	.39
1B3GT	1.10	2C51	5.75	4C22/HF100	9.95	6BL6	64.50	EF50	.35	450TH	39.50	811	6.50	1629	.39
1B22	2.95	2C52	4.50	4C27/CV92	3.95	6BL7GT	1.10	VT52	.49	GL451	.85	814	3.85	1632	.39
1B23	8.95	2D21	1.49	4C35	34.50	6C21	24.95	RK60/1641	2.25	GL464A	4.95	815	2.00	1644	.89
1B24	12.50	2D21W	2.49	4E27/		6F4	5.50	RK872	.89	CK512AX	1.98	829	9.95	2051	1.19
1B26	2.50	2E26A	4.50	MK257B	16.50	6F7	.98	RK873	.89	527	12.50	829B	12.50	5590	17.95
1B27	17.95	2E29	3.25	4J21	129.50	6F8G	1.19	75TL	6.50	WL530	19.95	832A	9.95	5511	
1B32	3.75	2E30	1.98	4J22	129.50					WL531	5.98	833A	39.50	5647	4.50
1B37	14.95	2J21	9.95	4J23	129.50					WL532	3.10	836	1.95	6054	4.50
1B38	29.95	2J22	7.95	4J26	129.50					KU676	39.50	837	1.45	5570	5.95
1B42	12.50	2J26	19.95	4J27	129.50					700A/B/C/D	16.50	838	2.95	5676	3.35
1L4	.69	2J27	19.95	4J28	129.50					702A	2.75	843	.39	5694	3.00
1LN4	.79	2J31	29.50	4J29	149.50					703A	4.95	845	3.95	5702	6.50
1LN5	.79	2J32	29.50	4J30	245.50					705A	1.95	851	49.50	5703	1.90
1N21B	3.50	2J33	29.50	4J31	99.50					706BY	29.50	852	19.95	5726	2.95
1N21C	22.50	2J34	29.50	4J33	99.50					706CY	29.50	860	4.95	5750	3.95
1N22	1.25	2J36	99.50	4J35	99.50					706FY	49.50	861	29.50	5751	2.00
1N23	1.49	2J40	27.50	4J41	99.50					706GY	49.50	863	1.10	5784	5.50
1N23A	2.75	2J48	22.95	4J52	299.50					707A	7.95	866A	1.49	5814	4.50
1N23B	4.95	2J56	169.50	4X150A	35.50					707B	14.95	872A	2.75	5844	3.95
1N34	.69	2J61	32.95	5BP1	4.50					708A	3.95	874	.49	5931	2.95
1N40	7.95	2J62	32.95	5BP4	4.50					713A	1.98	876	.49	5935	1.00
1N41	1.40	2K22		5DP1	19.95					714AY	4.50	884	1.75	6057	3.95
1N54	.89	2K25	28.50	5FP14	16.95					715A	1.95	889RA	149.50	6005	4.95
1N55	2.75	2K25/723A/B	29.50	5GP1	4.50					715B	8.95	921	1.75	6012	2.95
1N56	.89	2K26	65.00	5JP1	24.50					715C	22.95	923	1.85	6013	2.95
1N58A	1.19	2K39	99.50	5JP5	24.50					717A	1.10	931A	6.50	8020	1.25
1N60	.60	3A4	.79	5J23	59.50					720BY	59.50	954	.39	8025	4.95
1R4/1294	.99	3A5	1.39	5J26	89.50					720CY	59.50	955	.49	9001	1.75
1S5	.79	3AEGT	1.39	5J30	5.95					721A	1.95	956	.49	9002	1.50
1T4	.79	3AP1	18.95	5R4GY	2.00					724A	1.95	957	.49	9003	1.75
1T5GT	.89	3B7/1291	.59	5V4G	1.10					723A/B	16.95	958A	.49	9004	.98
1T6	.99	3B24	4.95	523	.99					724A	4.50	991	.39	9005	1.75
1V	.79	3B26	3.50	6A3	1.69					724B	2.75	1805	.69	9006	.69
1X2A	.99	3C23	9.95	6AB7/1853	1.29					725A	4.95	1806	2.75		
2AP1	9.95	3C24/24G	1.75	6AC7	.99										

Special! RCA AUDIO CHANALYST Type 170-A $195.00

Special: VACUUM CAPACITORS
12-20, $6.50 12-32, $9.50 50-32, $12.50

YOUR SURPLUS WANTED
We Pay Highest Prices!

6K4	4.50	FG81A	3.75
6J6	2.25	83	1.29
GL6G	1.39	83V	1.10
GL6GA	1.39	VT98-8R	9.95
6SN7GT	.98	98R	5.95
6SN7WGT	1.98	100TH	9.50
6V6GT	.79	114B	.75
7B4	.89	VT-127A	3.75
9LP7	7.95	VT158	12.50
12AH7GT	1.29	FG-172	34.50
12C8	.98	201A	.98
12DP7	16.95	201C	3.95
12H6	.89	204A	49.50
12S47	.89	211/VT4C	.65
12SF5	.79	217C	6.95
12SJ7	.89	250B	8.95
12SN7GT	.89	250TH	22.00
12SQ7GT	.79	304TH	12.95
15E	.98	304TL	9.95
15R	.69	307A/RK75	4.25
FG-17	4.50	327A	4.50
T-20/1623	3.75	350A	6.95
24A	.98	350B	4.95

All Prices F.O.B. Los Angeles, subject to change without notice. Minimum order $3.00.

J. S. H. SALES CO.
Dept. E-10, 7552 Melrose Ave.
Los Angeles 46, California

1000's of other types in stock. Send us your requirements.

BEST BARGAINS at CIRCLE

DRILLS
BRAND NEW Imported, UNCONDITIONALLY GUARANTEED. Purchasing Agents, Dealers, Quantity Buyers—inquiries invited. Immediate delivery from stock. (Complete list upon request.)

High Speed Twist Drills—Straight Shank
60 pieces—#1 to 60 ..... Per Set $14.95

		High Speed	Semi-High Speed
Set #2— 7 pcs.	1/16, 3/32, 1/8, 5/32, 3/16, 7/32, 1/4	$2.49	$1.29
Set #3—10 pcs.	1/16, 5/64, 3/32, 7/64, 1/8, 9/64, 5/32, 3/16, 7/32, 1/4	2.98	1.69
Set #4—13 pcs.	1/16, 5/64, 3/32, 7/64, 1/8, 9/64, 5/32, 11/64, 3/16, 13/64, 7/32, 15/64, 1/4	3.98	2.98

DYNAMOTORS—GOOD—USED—TESTED

DM-18	$4.50	SS-104	$4.50
DM-20	4.50	PE-94	4.50
DM-32	4.00	PE-115A Leland Inverter	29.00
DM-33	4.00	PE-118A Inverter	15.00
PS-225	4.50	PE-119A Inverter	16.00
BD-BG 68	4.50	PE-218 Inverter	12.00

D-104 Dual 12 V. Input—Output 250 V. @ .100 Amp—440 @ .200 Amp—Brand New $19.00

CONTROL BOXES

C-237/APG 15	$5.97	BC-AR-408	1.55
J-141/APG 15	8.95	BC-451 ARC-5	.89
C-260A/ANQ-1A	4.95	BC-442 ARC-5	
C-237/APQ7	1.49	w/condenser	2.75
RE-ARRI	1.49	BC-442 ARC-5	
BC-AE-231	1.19	L/condenser	1.69

G.E. Circuit Breaker—MGM 800, 24 V, 200 Amps—New $1.95
Leland Voltage Regulator—Type "B"—21-30 V/Input, 5.0 Load Amp.—New 2.25
C.D. 307A Extension Cords—w/PL-55, JK-26 ..... .89
Trimm Headsets—High Impedance—Excellent Per Pair $1.95
Navy Type H8-33—Excellent (ANB-HI Units) Per Pair 1.89
T-20-B Microphones w/JK-46—Brand New Each 1.19
T-30 Microphones w/PL 291 Plug—Excellent Each .29
RCA Frequency Limit Monitor w/tubes, excellent $49.00
BC-433 Compass Receiver less tubes, as is, clean 11.00
BC-375 Transmitter w/tubes and one tunning unit, excellent condition 19.95
BC-1153 Indicator Unit with cathode ray tube and cables 8.95
BE-73 Switch Box $15.00
24 Volt Motor—P/O—RL-42, 1/3 H.P.—8500 RPM 1.35
RF-9/UPT Modulator Adapter 11.50
BC-937 B Voltage Regulators—Good, Used.. 7.95
Standard Brand—1.75 MU-F, 330 V, 60 cyc. 1.19
Paper Capacitor—#173346, 250 MFD @ 250 V 1.19

TERMS—Send 25% deposit with order, balance C.O.D. Shipped F.O.B., N.Y.C. (N.Y.C. residents add 3% sales tax.)

CIRCLE SALES CORP.
113 GREEN ST., N.Y. 12, N.Y. - WOrth 4-1541-2

STANDARD BLANK

CHASSIS

- CADMIUM & BLACK
- ORIGINAL PAPER WRAP
- 80,000 PIECES IN STOCK

Minimum Order — 10 Pieces

BLANK CHASSIS

Size	Price
4 x 17 x 3	$1.03
4½ x 5 x 1⅜	.62
5 x 7 x 2	.64
5 x 9½ x 2½	.70
5 x 9½ x 3	.87
5 x 10 x 3	.92
5 x 13 x 3	1.09
5½ x 10 x 3	.92
6 x 13½ x 2½	1.10
7 x 7 x 2	.83
7 x 9 x 2	.94
7 x 11 x 3	1.00
7 x 12 x 3	1.18
7 x 13 x 3	1.12
7 x 15 x 3	1.30
7 x 17 x 2½	1.39
7 x 17 x 3	1.49
8 x 10 x 2½	1.23
8 x 12 x 2½	1.30
8 x 12 x 3	1.31
8 x 17 x 2	1.48
8 x 17 x 3	1.47
8½ x 15 x 3	1.47
10 x 12 x 3	1.51
10 x 14 x 3	1.52
10 x 17 x 2	1.47
10 x 17 x 3	1.52
10 x 17 x 4	2.17
10 x 17 x 5	2.30
10 x 20 x 3	1.70
11 x 17 x 2	1.87
11 x 17 x 3	2.06
12 x 17 x 2	1.84
12 x 17 x 3	1.89
13 x 17 x 2	2.19
13 x 17 x 3	2.37
13 x 17 x 4	2.79
13 x 17 x 5	3.64

REMOVABLE-TOP

10 x 12 x 3	$2.61
10 x 17 x 4	3.85
13 x 17 x 3	3.90
13 x 17 x 4	5.70

BOTTOM PLATES

Size	Price
4 x 17	$ .50
5 x 7	.37
5 x 9½	.37
5 x 10	.40
5 x 13	.50
5½ x 13⅜	.47
5½ x 10	.47
7 x 7	.45
7 x 9	.55
7 x 11	.61
7 x 12	.63
7 x 13	.66
7 x 15	.69
7 x 17	.68
8 x 10	.66
8 x 12	.72
8 x 17	.88
8½ x 15	.68
10 x 12	.68
10 x 14	.79
10 x 17	.92
10 x 22	1.30
11 x 17	.91
11 x 17	1.01
13 x 17	1.19

SLOPING PANEL CABINET

8 x 8 x 8	$4.15
8 x 10 x 8	4.55
8 x 14 x 8	5.40
12 x 18 x 12	7.84

UTILITY CABINETS

2 x 4 x 4	$ .85
2 x 5 x 4	.90
4 x 5 x 6	1.12
5 x 6 x 9	1.68
6 x 6 x 6	1.09
6 x 7 x 12	2.16
7 x 9 x 10	2.00
7 x 9 x 15	2.98
8 x 10 x 10	2.46
8 x 10 x 16	3.42

HAROLD H. POWELL
2104 MARKET STREET
PHILA. 3, PA. LOcust 7-5285

FOR SALE

Priced right for quick disposal

4	Line Starters	3 pole, 300 amp, 230 volt Westinghouse #15-825
2	Circuit Breakers	3 pole, 225 amp, 600 volt General Electric #AE1A
25	Circuit Breakers	3 pole, 200 amp, 230 volt Westinghouse #2908
25	Circuit Breakers	3 pole, 125 amp, 230 volt Westinghouse #2906
41	Circuit Breakers	3 pole, 25 amp, 250 volt Westinghouse #2900
67	Circuit Breakers	3 pole, 15 amp, 230 volt Westinghouse #2900
347	Meters	75-0-75 MA Westinghouse 3½" case
13	Meters	0-300 volts AC Westinghouse DC37
27	Meters	250-0250 UA Weston
1432	Lamps	3 watt, 115 volt Type S6
2276	Connectors	AN3106-14S-2S
450	Receptacles	Amphenol 83-1R
16	Capacitors	10 mfd., 1000 volt oil filled
725	Capacitors	8 mfd., 600 volt oil filled
33	Capacitors	4 mfd., 1500 volt oil filled
1827	Capacitors	.002 mfd., 1500 volt mica F2L
43	Capacitors	.0001 mfd., 6000 volt Type G3
13	Transformers	consisting of 3 single phase transformers at 300 VA each & 6 capacitors @ 5 mfd., 660 VAC Sola Electric No. 30963
12	Transformers	plate, 3 phase, 215 volt primary 3480 volt secondary CT @ 1.7 amps Acme T-5376
10	Water Jackets	RCA for 888 tube
10	Tubes	813
2	Tubes	4-250A
3	Tubes	4-125A

Many more items included. Tell us your needs.

Send inquiries to

FS-3127, Electronics
330 W. 42nd St., New York 36, N. Y.

FOR QUICK ACTION — *Any Kind of Electronic Equipment Bought or Sold* — OFFERING—800 RAYTHEON—CK503AX—.65¢ each.
We BUY FROM YOU FOR YOU
We SELL TO YOU FOR YOU

ELECTRONIC SURPLUS BROKERS
148 CHAMBERS ST., NEW YORK RECTOR 2-1591

OUR EXPORT DEPARTMENT AVAILABLE FOR SPECIAL SERVICE TO OVERSEAS CUSTOMERS

COMPASS

COMMUNICATIONS COMPANY

393 GREENWICH STREET
NEW YORK 13, N. Y.

BEekman 3-6510

CABLE ADDRESS: COMPRADIO

WE MAINTAIN OUR OWN FULLY EQUIPPED TESTING LABORATORY IN THE SAME BUILDING AS OUR MAIN WAREHOUSE TO TEST ANY ITEM WE SELL

• CONVERSION EQUIPMENT

—MOTOR GENERATORS
—CONVERTORS
—DYNAMOTORS
—INVERTERS
—POWER SUPPLIES
—RECTIFIERS

• TEST EQUIPMENT

• RADAR

MARINE, GROUND & AIRBORNE

AN/APS-2	SA-2	SF
APS-3	SL	SG
APS-4	SN	SL
APS-6		SCR-545
APS-13	SO	SCR-720
APS-15	SQ	
	SJ	

TRANSMITTING STATIONS

1 KW—200-500 kcs, complete with 220-440 volt, 3 ph. 50-60c. power supply—**Price $2,500.**

800W—(400 watt phone) Western Electric 10-channel automatic dial selection, 2.0-20.0 mcs. with 220 volt, 1 ph, 50-60c, power supply. SAME TRANSMITTER AS USED ON S.S. "QUEEN MARY"—**Brand New. Price $4,000.00.**

1 KW—FM Broadcast station, complete with monitor, all tubes, antenna and waveguide, Mfr. G. E. **$1,500.00**—at location, N. Y. C.

★ *All equipment new or reconditioned, checked in our laboratory and ready for operation.*

• TELEPHONE EQUIPMENT

Portable and Stationary Switchboards and Supplies

BD—71, six-line portable switchboard

BD-72, twelve-line portable switchboard

SELECTED EQUIPMENT

TCS—Collins mfd. Navy radiotelephones for shipboard and mobile use, complete with all accessories for operation from 12, 24, 110, 220 volts d.c. and 110 or 220 volts a.c.

TDE—Navy or commercial marine transmitters, complete, 110 & 220 volts d.c. and a.c.

TBK—Navy high frequency transmitter, 2-20 mcs; 500 watts output. Supplied complete with m/g and starter for d.c. or a.c. operation.

TBL—Navy all-wave transmitter; 350 watts output; CW and phone. Supplied complete with m/g and starter for d.c. or a.c. operation.

TAJ—Navy intermediate freq. transmitter, 175-550 kcs; 500 watts output. Supplied complete with m/g and starter for a.c. or d.c. operation.

SCR-284—the famous mobile and ground station for field use. Large quantity of complete sets available.

MAG—10 cm. portable link radar transmitter receivers. 6-volt operation.

and TUBES—MAGNETRONS, KLYSTRONS, SPECIAL PURPOSE and TRANSMITTING TYPES

TYPE	PRICE	TYPE	PRICE	TYPE	PRICE	TYPE	PRICE	TYPE	PRICE	TYPE	PRICE
O1A	——	2J33	$100.00	4C28	$35.00	307A	$5.00	723A/B	$25.00	2x2/879	$1.75
OC3	$1.60	2J36	100.00	4E27	17.50	371B	2.50	724B	6.50	954	1.00
OD3	1.50	2J38	17.50	4J33	190.00	388A	2.75	725A	——	955	1.00
C1A	6.00	2J39	17.50	4J52	350.00	446A	2.00	730A	——	956	1.00
C1B	7.00	2J42	150.00	5J23	——	446B	4.00	803	7.00	1616	2.75
C6A	——	2J50	75.00	5J26	350.00	450TH	45.00	807	1.65	1619	.75
C6F	12.50	2J61	75.00	6C21	29.50	450TL	45.00	813	9.00	1624	2.00
C6J	——	2J62	75.00	10Y	1.25	464A	9.50	829A	12.00	1625	.65
1B22	3.95	2K22	——	100TH	9.00	705A	3.50	832A	10.00	1626	.75
1B23	10.00	2K25	35.00	204A	60.00	706A-GY	45.00	836	4.75	1629	.65
1B24	——	2K26	150.00	211	1.00	707B	25.00	837	2.75	1636	3.00
2B22	4.95	2K29	35.00	250TH	20.00	714AY	17.50	843	——	1642	3.50
2B26	3.75	2K41	150.00	250TL	20.00	715B	17.50	849	30.00	2030	2.00
2C40	18.00	2K45	140.00	304TH	15.00	720	——	851	80.00	8012	4.25
2C43	25.00	2K54	150.00	304TL	15.00	721A	3.75	860	5.00	8020	3.50
2D21	1.70	2K55	150.00					861	40.00	8025	7.00
2E22	3.75	3B24	6.50					865	1.40	9001	1.65
2J21	17.50	3B27	10.00					872A	3.85	9002	1.50
2J22	17.50	3B28	10.00					874	1.50	9003	1.75
2J26	27.50	3C31	5.75					889R	195.00	9004	1.75
2J27	27.50	3E29	15.00					891R	250.00	9005	1.90
2J31	27.50	4C27	25.00					892R	250.00	9006	.50

Special C.R. Tube Offering:
12DP7A (in date)—39.50

WE GUARANTEE EVERYTHING WE SELL

TIME DELAY

RELAY 115v 60cy adjustable 6 sec to 2 minutes Cramer TD2-120S. Also TD60S 6 to 60 sec. . . $12.95
MOBILE XMTR Link 250TFM w/6v dynamotor & tubes 30-42mc 15wCFM 8x17x8". 25w out. used. . . $59.50
SYNCHRO MOTOR 1F Special 115/90v 400cy. $11.95
SLOWER MOTOR 400-1800rpm 115v **EAD** J31C. $9.95
RELAY 3PDT 24vdc 250 ohm Clare Type K. . . $1.55
250 WATT OUTPUT XFRMR PP-8ohm KS-9496 . . .$14.95
FIL XFRMR 6.3 @ 1.5A (other sizes avail). . . . 5.95
CHOKE 4H 70ma. . . .69c, 2H 70ma 100 ohm. . . $.49
SILV TRMR TC2A 1.5-7, 7-45 or 30c; MICA 3.50 **8c**
AN3106-10S-2S, PL-68, PL-259A, 83-1R, S6T, JK34-34
CONDENSERS: BATHTUB, MICA, AIR, OIL, HV, CER.
SPARES for: AN/TRC-1, MK11 Radar, AN/TPN-2
POTS, RELAYS MINES, 3AG&MDL fuses, Switchs
35w ISOLATION & othr xfrmrs, miniahide, sockts
2% .002 Silver Mica; tubes; **MANY MISC. ITEMS**

EMPIRE ELECTRONICS COMPANY

409 Avenue L — Brooklyn 30, N. Y.
Cloverdale 2-2411 — BRyant 9-1220, 1221

SURPLUS

BOUGHT & SOLD

GOULD GREEN — 252 Greenwich St. — WOrth 4-8314—NYC 7

WE HAVE LARGE QUANTITIES OF

RADIO TUBES

TYPE	PRICE	TYPE	PRICE	TYPE	PRICE	★★★★★★★★★★★★	
OZ4A	$0.70	6BQ6GT	$0.93	6SK7GT	$0.96	★	★
1G6GT	0.72	6BE6	1.20	6SN7GT	1.20	★ TYPE	PRICE ★
1LN5	0.80	6C4	0.86	6SS7	0.95	★ 8E32	$2.50 ★
1R5	0.90	6C5GT	0.51	12AA6	0.48	★ 6C21	30.00 ★
1S4	0.86	6C6	0.75	12SH7	0.96	★ 307A	3.75 ★
1T4	0.86	6H6	0.94	12SK7	0.98	★ 357A	22.50 ★
5U4G	0.80	6J5	0.60	12SQ7GT	0.30	★ 805	2.90 ★
6AB7	0.90	6J5GT	0.51	12SR7	0.90	★ 808	1.70 ★
6AC7	1.20	6K6GT	0.91	35Z4GT	0.85	★ 9308	3.00 ★
6AL5	1.00	6K7GT	0.70	35Z5GT	0.75	★ 9005	1.30 ★
6AQ5	0.40	6SQ7	0.90	50L6GT	0.90	★	★
ABC	0.93	6SK7	0.96	42	0.76	★★★★★★★★★★★★	

This offer subject to change and prior sale.

SPECIAL SALE TYPE 805 — **OUR PRICE: $2.90** — List Price: $13.50

METROPOLITAN OVERSEAS SUPPLY CORPORATION

MANUFACTURERS AND DISTRIBUTORS OF ELECTRONIC PRODUCTS

1133 BROADWAY, NEW YORK 10, N. Y. — CHELSEA 3-1105

NOW IN OUR NEW, ENLARGED QUARTERS!

Available for IMMEDIATE DELIVERY

- BC-348
- RTA-1B
- TA2-J24
- ARC-1
- BC-797 VHF Trans. & 201A RCVR
- SCR-284

MANY TV SETS AVAILABLE
Write for complete information and our low prices!

- RADAR COMPONENTS
- REMOTE CONTROLS
- TRANSMITTERS—RECEIVERS
- IE-19
- TS-89
- TS-268
- METERS

We'll Pay Top Dollar for the Following Equipment

WANT TO BUY

- R89/ARN-5
- ARC-3
- RTA-1B
- ARC-1
- ART-13
- TA-2J

- ANY TS, I, IE, TEST SETS, EQUIPMENT and PARTS

WE HAVE BRAND NEW MOBILE EQUIPMENT, TV and APPLIANCES TO TRADE—or WE'LL PAY TOP PRICES!

WE HAVE MOVED
and can now offer you additional facilities and faster service:
- NOW IN OUR OWN CHECK-OUT SHOP!
- ALL MATERIAL CHECKED AND GUARANTEED BEFORE SHIPPING

Please change your records to:
ALVARADIO SUPPLY CO.
4665 Melrose Avenue
Los Angeles 29, Calif.
Phone: DUnkirk 8-2211

ALVARADIO SUPPLY CO.

A Division of ALVARADIO INDUSTRIES
4665 Melrose Avenue — Los Angeles 29, California
Telephone DUnkirk 8-2211

REAL VALUES!

TUBES

3FP7	$1.95	5CP1	$4.95
4AP10	.95	5FP7	1.95
5BP4	3.95	16JP4	19.95
16DP4	19.95	304 TH	8.95
9001	1.39	304 TL	8.95
9003	.98	830 B	2.95
9003	1.49		

RA 52—RECTIFIER

A transtat controlled rectifier to produce high voltage DC from 110 VAC 60 cycle source. Up to 11,500 volts DC at 50 watts. Metered high voltage (0-15KV) and current (0-20 MA). New **$74.50**
Some available with small repair or minor part replacement, less tube..... only $49.50

SCR 625 Famous Army Mine Detectors for prospectors—miners—oil companies—plumbers—etc.. This unit is being offered now at a considerable reduction in price. Recently advertised at $78.50 it is now available in the same brand new wrappings in suitcase style carrying case (less batteries). **$59.50** WHILE THEY LAST

USED, LIKE NEW **$39.50**

APT1	MD4/APS2	R18/APS3
APT2	MD5/APS3	R78/APS15
APT3	MD22/UPM2	AS18/APS15
APT4	MD38/APQ13	RC213
T35/APT-5	TS16APN	RT34/APS13
PP-104	TS27/TSM	RT28/APG4X
BC638	TS43	RT39/ARC4
BC1287	TS89	RT48/TPX
BC1277	TS92	RT73/UPN
1-83G	TS131	RT78/APS3
1-86A	TS159	AN/APT4
1-114	TS179	APS4
1-183	TS184	TS51
1-185	TS281	TS69
1-187	TA-2324	BC1155
1-198	RM12/TPS10	TS34/AP
1E36A	R9/APN4	

PRICES UPON REQUEST
We carry a complete stock of electronic equipment. A copy of our new bulletin is available upon request.

ARROW SALES, Inc.

Dept. E6
1712-14 S. Michigan Ave., Chicago 16, Ill.
PHONE: HArrison 7-9374

Regulated Tube Rectifiers—Western Electric #J86207 Input 105 to 125 volt 50-60 cycles. Output 50 volt 3 amp. D.C...**$85.00**

35 mm. Slide Cabinets will hold 2,318 slides, also contains a 28x20 Da-Lite screen, overall size 32¼"x21"x6" finished in black simulated leather.....**$25.00**

Eastern Air Device J50E Dual Centrifugal Blower, 115 volt 60 cycles 0.1 amp. 1 PH 20 C.F.M. Continuous duty 1.0 M.F.D. Capacitor start. Without capacitor...**$18.25**

Miniature Lamp T1¾, 3 volt .19 amp. Airplane Indicator Amb. Ctd. 10 for **$1.00**; 100 for **$8.50**

Ammeter 150/300 dual range Triplett 341A 3½" rectangular flush bakelite 5 amp. Movement @ $4.95 with external current transformer for 150 amp.....**$7.50**

Drierite—The Versatile indicating Desiccant-size #8 mesh in 6 oz. bottles, 24 bottles to a case. In case lots $4.80 per case, minimum order 6 bottles for.....**$1.50**

Selenium Rectifier—Full wave bridge, G.E. model 6R5FB3, up to 54 V. AC, 150 mill. Cont. Duty, 12-1" plates 1500 ea. available.

Vibrator Tubes, 6 volt 4 Prong OAK V6506 .....**89¢**
12 volt 4 Prong KS5566 List 04.....**89¢**
Minimum order 3 for **$2.50**; 100 for..**$75.00**

SEND FOR FREE BULLETIN

DIgby 9-2188-9

A. Cottone & Company

Electronic Mechanical & Optical Components
336-340 CANAL ST., NEW YORK 13, N. Y.
ALL PRICES F.O.B. N. Y. CITY

MANUFACTURERS! EXPORTERS! PURCHASING AGENTS!
- HONESTY
- INTEGRITY
- QUALITY OF PRODUCT

- Radio and Receiving Tubes
- Transmitting & Special Purpose Tubes
- Radio and Electronics Parts and Equipment
- All Types of Electrical Wire, Magnet Wire, and Cable

Write — Wire — Phone For Your Special Needs

We are also bonafide General Purchasing Agents.
CAN WE HELP YOU?
References: Dun & Bradstreet.

Electronic Expediters

225 N. Wabash Ave., Dept. E, Chicago 1, Ill.
Phone ANdover 3-0841

BRANCH OFFICES
9015 Wilshire Blvd., Beverly Hills, Cal., CR 4-6237
507 Fifth Ave., New York 17, New York, MU 7-0084

25 CONDUCTOR CABLE made up by Western Electric in 50 foot lengths with SS24CCT connectors on each end. Each conductor is #22 standard and rubber covered. Although the O.D. is only 9/16 inches there is a heavy live rubber jacket.
Per length, only.....$9.95

"VITAMIN Q TUBULAR CONDENSERS

Cat. No.	Mfd.	Volt	Qu.	Price
774-606A*	.0033	600	231	5.95
G191P10391	.01	100	60	1.50
G91P16993	.01	200	250	1.60
G88P10394	.01	400	180	1.65
G191P22391	.022	100	20	1.65
G191P68352	.068	200	45	1.65
G191P82394	.082	400	48	1.65
G91P15491T	.15	100	199	1.65
G191P22491	.22	100	49	1.65
G191P27491	.27	100	23	1.65
G191P4791	.47	100	140	1.75
G91P56492	.56	200	28	1.75
G91P68492	.68	200	20	2.25
G91P10592	1	200	78	2.29
XFC1809*	1	600	20	2.29

*not Vitamin Q but similar

THESE ULTRA HIGH QUALITY CONDENSERS ARE MADE BY LEADING MANUFACTURERS.
Feature
- 20,000 Megohm or More
- Subminiature
- Glass Seal Terminals
- Up to $7.50 regular

Widely Known for Fair Dealing and Good Service

HAROLD H. POWELL
2104 MARKET STREET
PHILADELPHIA 3, PENNA.
PHONE LOcust 7-5285

25 WATT POTENTIOMETERS

Ohm	Bush	Shaft	Cat #	Price
2	5/8s	1/8sd	O-H	$1.04
3-1	1/2	1/2	I	1.04
15	3/8	3*	C	1.04
15	1/8	1-1/8	D-245	1.04
15	1/2	1-1/4	I	1.04
20	1/2	1/2F	D-245	1.04
25	1/8	1	D-245	1.04
30	3/8	1	C	1.04
50	1/8	1-1/8	D-245	1.04
50	5/8	1/8sd	O-H	1.04
75	1/2	7/16	O-H	1.04
100	1/8	1	D-245	1.04
350	1/8	1-1/8	O-H	1.04
500	1/8	11/16	D-245	1.04
4K	1/2	1/2	O-H	1.17
5K	1/8	1-1/16	D-245	1.20
5K	1/2	1/8sd	I	1.24
5K	1/8	7/8	D-245	1.24
200K	1/2	1/8sd	D-245	1.40

These excellent wirewound controls are manufactured by the leading companies and are in the original cartons. Priced ridiculously low, only 20% of list. SATISFACTION GUAR.

50 & 100 WATT POTENTIOMETERS

Ohm	Watt	Cat. #	Price
75	100	O-K	$2.15
500	50	O-J	1.41
500	50	D	1.41
500	100	O-K	2.15
1K	50	O-J	1.41
1.5K	100	O-K	2.34
2.5K	50	O-J	1.41
5K	50	O-J	1.56

WIREWOUND POTENTIOMETERS

Leading Makes — Ohm	Bush	Shaft	Clean New Cat #	Watt
10	3/8	1-5/8	I	2
15	3/8	3	C	2
20	1/2s	1/8sd	CTS	2
25	1/8	1	M	4
25	1/8	1	W	4
25	1/8	1-1/4	CTS	4
50	3/8	1/8sd	M	4
100	5/8	1/8f	I	2
100	1/8	5/16	CTS	4
200	3/8	7/8	CTS	2
200	5/8s	1/8 sd	CTS	4
200	1/2	1-1/16	CTS	4
250	1/2s	1/8sd	CTS	2
350	3/8	1-1/8	I	2
350	1/8	1/2	CTS	2
400	1/8	1-1/4sd	CTS	4
750	1/8	1/8sd	CTS	4
1K	3/8	1/8	I	2
1K	3/8	3/8	CTS	2
1K	3/8	1/8sd	CTS	4
2K	1/4	1/8	CTS	2
2K	1/2s	5/16sd	CTS	4
2K	1/8	1-1/16	CTS	4
2K	1/2	1-1/2	TRF	4
3K	3/8	1/2	CTS	4
3K	3/8	1-1/2f	C	2
5K	3/8	7/16sd	CTS	2
5K	1/2	1/2sd	TRF	4
5K	1/2	1-7/16	TRF	4
5K	7/16	1-7/16	C	4
7.5K	1/2	1/8	CTS	4
10K	3/8	1/2sd	CTS	2
10K	1/8	1/8f	I	2
15K	1/8	1/2sd	CTS	4
20K	5/8	1-3/16	CTS	4
25K	5/8	5/8	CTS	4

ONLY 45¢ ea

REVERSIBLE REMOTE CONTROL DRIVE

A.C. motor driven unit designed for 'lazy man' control of 1951 Zenith TV. Operates from 115 volts 60 cycles; but, self incorporated transformer permits low voltage control leads. Includes attractive plastic hand grip switch with black & white control buttons, one for each direction. Motor drives worm gear which is moved against a nylon gear by solenoid. Made this way so that TV set could be tuned manually. Output to ¼ inch shaft is approximately 4½ RPM. Intermittent duty. Includes 17 feet three wire control cable with plug. Brand New. ACT NOW! Our limited supply going fast at.....$10.95

COAXIAL CONNECTORS

Type	Price
UG158B/U	$1.35
UG159B/U	1.35
UG21/U	.90
UG22/U	1.25
UG23/U	1.10
UG24/U	1.10
UG25/U	1.10
UG27/U	1.10
UG58/U	.90
UG646A/U	2.35
UG61A/U	2.35
UG85/U	1.75
UG87/U	1.50
UG88/U	1.50
UG89/U	1.50
UG97/U	4.90
UG97A/U	4.20
UG98/U	2.25
UG102/U	1.15
UG103/U	.85
UG104/U	1.40
UG105/U	1.25
UG108/U	1.10
UG132/U	4.50
UG167/U	2.00
UG171/U	1.95
UG172/U	.40
UG175/U	.35
UG176/U	.35
UG281/U	2.25
J281	4.50
UG224/U	1.40
SO239	.40
SO239Y	.90
UG245/U	2.25
UG258/U	2.45
PL258	.90
PL259	.90
PL259A	.35
UG260/U	1.35
UG262/U	1.75
UG262/U	1.60
UG274/U	3.75
PL274	1.30
UG275/U	4.50
UG290/U	1.50
UG291/U	1.75
UG296/U	1.75
UG306/U	2.95
UG335/U	3.75
UG342/U	2.95
M358	1.62
M359	.90
UG422/U	1.25
UG625/U	1.50

PULSE FORMING

DELAY LINE 15-E4-.91-400-50P. Sprague #892-5245. H633. 4x5x7 inch oil filled with 3½ inch insulators. 0.91 Microsecond. 15KV $9.90

AN CONNECTORS

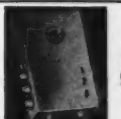
COMPLETE STOCKS. SEE JANUARY ELECTRONICS FOR FULL LISTING WITH PRICES.

TURRET SOCKETS

SAVE TIME
BETTER CIRCUIT

Socket	Height	Stock	Price
Octal	1 1/2"	18-8-ST	$1.50
Octal	2"	8-8-ST	.57
Octal	1 1/2	6-M-ST	.54
Min.	2"	12-NS-32	.73
Min.	2"	8-M-ST	.63
Min.	1 1/2	6-M-ST	.58
Min.	1"	4-M-ST	.50
Noval	2"	12-NB-32	.78
Noval	2"	8-M-ST	.66
Noval	1 1/2	6-M-ST	.61
Noval	1	4-M-ST	.53

DO'S Speed Delivery



UTAH 9287D

FOR SALE

Good Used Glass Working Equipment

Stem machines; stationary vacuum exhausts; hydrogen ovens; exhaust machines; etc.

HAYDU BROTHERS
PLAINFIELD, N. J.

DEPENDABILITY IN ELECTRONICS

Attn: Industrial Purchasing Agents . . .

Our new Radio Master Catalogue is available to you at no charge upon receipt of your request on your letterhead. We are National Distributors of General Electric, Sylvania, Ohmite, Amphenol, Sprague, Aerovox, Sangamo, Stancor, Merit, A. H. & H., Simpson and many others. All telegrams, cablegrams, and inquiries acknowledged and promptly answered.

NORMAN RADIO DISTRIBUTORS INC.
94-29 MERRICK BOULEVARD JAMAICA, N.Y. - REpublic 9-4651

TUBES STANDARD BRANDS FIRST QUALITY TUBES

1B22	2.50	6 Amp		450TH	35.00	835	12.00	1632	.75	FG105	17.50	MAGNATRONS:		728EY	25.00
1P21	3.50	6V Tungar	3.75	531	4.50	836	2.25	1633	.65	HY31Z	2.50			728FY	25.00
2C22	.30	10Y	.35	559	1.25	837	1.35	1644	.35	HY114B	.65			728GY	35.00
2C26	.25	12A6	.65	701A	5.50	840	4.50	2051	1.25	HY615	.25	2J21A	10.00		
2C26A	.40	24G-3C24	1.75	702A	3.00	866A	1.25	9002	1.25	KC4	35.00	2J26	20.00		
2E22	1.10	35T Ion	3.50	704A	1.00	872A	2.25	9004	.50	OK159	45.00	2J27	17.50	C.R.T.	
2E25	4.75	101L	1.00	705A	1.35	874	1.10	9006	.25	RK34	.25	2J31	15.00		
2E27	2.50	203Z	4.50	708A	4.50	876	.35	CE2-A	1.50	RK47	3.75	2J40	35.00	3CP1	1.75
2E29	7.50	211	.50	715A	5.50	891R	175.00	CE2-B	1.50	RK47	1.10	2J61	20.00	3DP1	4.75
3C31	3.00	227A	3.75	715B	9.50	905	3.00	CE2-C	1.50	RKR72	.50	2J61A	45.00	3EP1	4.75
3D6	.50	249B	3.25	801A	.35	920	2.50	CE2-T	1.50	RK73	1.50	708A, B, C, D	15.00	5AP1	4.50
3D23	4.50	252A	3.50	803	3.50	954	.25	CE25C	1.25	RL5213	15.00			5BP4	4.50
4A1	1.50	286A	16.50	805	3.75	956	.35	C1A	4.50	SC968	2.50			5CP1	4.50
4B24	6.50	304TL	9.50	808	.75	958A	.40	C1B	3.50	SD828A	.35			5HP1	8.75
4B25	7.50	304TH	9.50	809	2.50	1613	.75	C3B	3.50	T2505	15.00	718CY	35.00	7BP7	9.50
4E27	13.00	305A	20.00	811	2.50	1616	.75	C6A	5.00	V81	12.50	725A	5.00	7HP4	7.50
4-125A	27.50	312C	1.00	826	1.25	1619	.25	C6J	6.50	VU560	1.50	728AY	25.00	9GP7	10.00
4X500A	75.00	316A	.50	827R	125.00	1625	.35	CK1005	.50	WL251	95.00	728BY	25.00	9LP7	6.50
5J29	11.50	327A	4.50	828	10.00	1626	.35	CRP72	1.25	WL481	1.50	728CY	25.00	10BP4	15.00
6-6	.35	446A	1.25	830B	3.00	1630	1.00	EL6C	8.75	WL532A	2.50	728DY	25.00	10CP4	15.00
						1631	1.00	FG57	14.50	WL670A	10.00				

SPECIAL: Ceramic disks, standard brand, 500 WVDC, all sizes in stock. Single size—$45 per M; dual—$55 per M.
Ceramic disks, standard brand, 1000 WVDC, all sizes in stock. Single size—$70 per M; dual—$80 per M.

All Radio & TV receiving tubes 50% off list. 25% deposit required on orders, rated firms send P.O. All merchandise guaranteed. Prices subject to change without notice. Merchandise subject to prior sale.

ROLE ELECTRONICS INC.

114-118 Liberty Street *Rector 2-8078* New York City

KEY ELECTRONICS

ATTENTION INDUSTRIAL USERS ! ! !

We have large stocks of the following items and we invite your inquiries.

- Amphenol Connectors
- Allen-Bradley Potentiometers
- A M P Terminals
- Burndy Hylugs
- T & B "Sta-Kon" Terminals
- Dialco Panel Light Assemblies
- Superior Powerstats
- Ferrule Type Resistors
- Relays, Transformers and Chokes
- Tube Sockets
- Hardware
- Contactors
- Magnet Wire & Hook-up Wire
- Vacuum Condensers
- Gas-filled Condensers
- Oil-filled Capacitors
- High-voltage Mica Capacitors
- High-voltage Oil-filled Capacitors
- Mica & Silver Mica Capacitors
- Tubes
- Switchboard Meters
- Crystal Diodes
- Interlock Switches
- Key Switches
- Type FP Capacitors
- Type G Capacitors
- Fiberglass Yarn
- Contactors & Contactor Coils
- T & B "Wedge-On" Terminals, Glass-enclosed Relays
- Welding Rod; including Type 347
- Tube Crocks

We invite inquiries regarding items not listed above.

Replies will be made to your inquiries within twenty-four hours after they are received by us.

Key Electronics Division

1801 North Longwood Street **Baltimore 16, Maryland**

Wilkens 6300

PHOTOCON SALES

1062 N. Allen Ave. *SYcamore 4-7156*
Pasadena 7, Calif. *RYan 1-8271*

WRITE FOR OUR WINTER 24 PAGE

SURPLUS SALES CATALOG

WE WILL BUY YOUR NEW OR CLEAN USED ELECTRONIC SURPLUS: ARC-1, ARC-3, BC-224, BC-348, BC-312, BC-342, ATC, ART-13, APS-13, BC-221, LM's, TS-12, TS-13, TS-23, TS-34, TS-35, IE-19A, I-222, SCR-522, TS-100, I-100, or any BC, I, IE, TS, APR.

WRITE FOR PRICES

APR4, T534/AP, TS13/AP, TS148/AP, ARC1, ART13, APA11, TS148, TS251, Etc.

Weston 769 Electronic Analyzer

APN-1 Altimeter Indicator 0-1 ma. shunt, 250° dial	LIKE NEW	$200.00
1E36A Test Sets for SCR-522	NEW	35.00
DuMont 241 Oscillograph	EXC.	300.00
DuMont 208 Oscillograph	EXC.	225.00
T.E. CRO5Y Oscillograph	EXC.	225.00
LM & BC-221 Frequency Meters xtal, tubes, cal. book	EXC.	99.50
804 EX-1 UHF Sig. Gen. S-350 mc. Complete		500.00
CRT-3 Two-channel Gibson Girl	NEW	75.00
Drafting Machine single scale 16" fulcrum less scale	EXC.	35.00
BC-463 Target amtr 5 channel control 68-73 with tubes	EXCELLENT	100.00
TS-34/AP Portable Oscilloscope	LIKE NEW	600.00
	EXC. COND	500.00

NOTE: One of the largest and most complete electronic surplus stocks in the country. We have thousands of tubes, capacitors, plugs, accessories, transmitters-receivers, test equipment, etc. Send us your requirements.

TERMS: Prices F.O.B. Pasadena, California. 25% on all C.O.D. orders. Californians add 3% Sales Tax. Prices subject to change without notice.

IN STOCK IMMEDIATE SHIPMENT

TUBES

6B8	.50	12F5GT	.48
6B8G	.55	12K8GT	.50
6J8G	.85	50	.65
6L7G	.65	70L7GT	.85
6S7G	.60	85	.57
6U7G	.50	807	1.40
12A6	.50	1619	.40

Please Write for Up-to-Date Special Purpose Tube List with New Low Prices

All listings are Quality Guaranteed. Inquiries regarding these and other requirements given prompt attention. Usual discounts to manufacturers and jobbers.

PARTS

TRANSFORMERS

PLATE TRANSFORMER

5000 volt AC, center tapped, 350 MA. Primary 115 volt, 60 cycle. Unmounted and not potted, overall dimension 6½ inches x 6 inches x 7 inches, weight 37 lbs. .....New. $25.00

PULSE TRANSFORMER

68G828-G1 .....New. $5.50

PLUGS

TELEPHONE PLUG, Equivalent to PL-55, with Screw Terminals Inserted. Samples furnished to quantity users....New. $.30

BUTTERFLY CONDENSER (APR-4)

Antenna Tuning Unit Condenser (C-302) for TN-17, 74-320 MC, in original package $12.50

All items subject to prior sale. Shipments BEST WAY C.O.D. if desired. Rated accounts net ROG.

T. R. LOWENTHAL CO.

ELECTRONIC COMPONENTS

Technical Radio Since 1919

1205 West Sherwin Avenue, Chicago 26, Illinois
Phone: Rogers Park 4-0784

ASTRO COMPASS

The Astro Compass is a precision instrument measuring 8¼" high x 3¼". Furnished in Carrying Case. Designed to provide accurately (a) True heading of Aircraft or boat. (b) True bearing of a distant object. (c) The relative bearing of distant objects.

Of special interest to Astronomers & Experimenters.

$9.50

Mounting Base for above Astro Compass..$1.10 Ea.

DIFFERENTIAL RELAY

Dual 8,000 ohm Coils, Armature pivoted between poles. Both Contacts normally open. Allied #D8X-23. 2.5 MA. .....**$4.50 ea.**

THYRITE RESISTOR

Non-linear 2 section. Each Section .1 Amp. 400-580 VDC Cat. #907170G1.....**$6.50 each**

SWITCHETTES

GE #CR-1070-108-J4. SPDT.....**$ .49 each**
10 for $4.50

DYNAMOTORS

5.7 Volts Input. Output 180 Volts DC .060 Amps. 4,000 RPM. Ideal for 6 Volt Mobile Application. **$10.95 each**

32 Volts Input. Output 330 Volts DC .1 Amp. 6,000 RPM .....**$3.50 each**

CAPACITORS

1 Mf.u	5,000 Volts DC	Cat. #22F225	$4.75	each
2 Mf.u	2,000 Volts DC	22F194	2.25	each
6 Mf.u	2,000 Volts DC	23F35	4.75	each
8 Mf.u	600 Volts DC	22F136	2.40	each
10 Mf.u	600 Volts DC	23F878	2.75	each

We invite inquiries on all Electronic Equipment including Relays, Motors, Switches, Pots, Resistors, Solenoids, Capacitors etc.

All prices shown F.O.B. New York

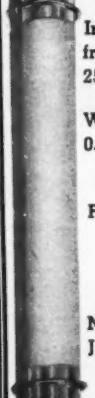
B & B DISTRIBUTORS

222 Fulton Street **New York 7, N. Y.**
REctor—2-0432

AT

Big Saving!

FERRULE-TYPE RESISTORS



Immediate delivery from our stock of over 250,000.

•

Wide assortment from 0.2 to 300,000 ohms.

•

ENAMEL—GLASS
FIXED—ADJUSTABLE

•

New and in perfect condition.

•

Nearly all made to JAN specification.

Write for Catalog E3

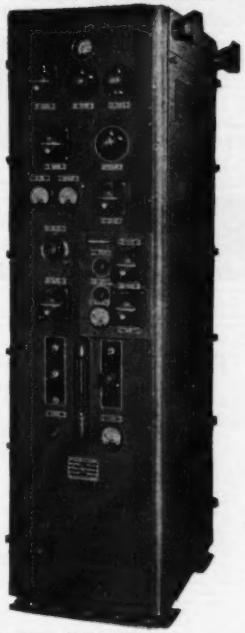
ELECTRONIC DIVISION

UNIVERSAL YONKERS CORP.

137 Alexander St. **Yonkers 2, N. Y.**

R.C.A. Model MI-8167
TRANSMITTERS

Point-to-point communications



Freq. Range: 2000 to 20,000 Kcs.
Output: 350 Watts C.W. 250 Watts Radio telephone
Input: 190 to 250 Volts AC 50/60 cps.
Size: 60" high, 17" wide, 27" deep.
Tubes: 807s, 813s, 805s, 866s.
Crystal Oscillator unit built-in, fully shielded and stable. All self contained including antenna network. Master Oscillator unit (available) fits in place of Xtal unit. Speech amplifier is only external unit and has 110/220 v. AC input, four stages, high gain. Total net weight, 625 lbs.

Complete! New! From Stock! Quantities!
Prices on Request.

COMMUNICATION DEVICES CO.
INCORPORATED
2331 Twelfth Ave. N. Y. 27, N. Y.

TEST EQUIPMENT

HI-POWER DUMMY LOADS

X Band, 1¼" x ⅝" guide, choke or plain flange, dissipates 350 watts average power continuously in still air, VSWR less than 1.15 between 7 and 10 KMC, weight 5¼ pounds.

X Band, ½" x 1" guide, choke flange, dissipates 250 Watts average power continuously in still air, VSWR less than 1.15 between 8.2 x 12.4 KMC, weight 3¼ pounds.

X Band, 1¼" x ⅝" guide, plain flange, dissipates 200 watts average power continuously in still air, VSWR less than 1.15 between 7-10 KMC, weight 3¼ pounds.

X Band, 1¼" x ⅝" guide, plain flange, dissipates 150 watts average power continuously in still air, weight 2 pounds 4 ounces.

S Band, 1½" x 3" guide dissipates 1000 watts average power in still air, VSWR less than 1.15 between 2.5 to 3.7 KMC, choke flange, weight 13 pounds.

TS-30, X Band Power Meter, measures 1 milliwatt to 1 watt of X Band average power for ⅝" x 1¼" wave guide.—$200.00.

TS-155 S Band Signal Generator and Power Meter.

X Band Frequency Meter, 8,500 to 9,600 megocycles, direct reading within 25 megacycles; within 4 megacycles with correction chart. Transmission type for ⅝" x 1¼" wave guide.

X Band Power and Frequency Meter for 8,500 to 9,600 megacycles measures 1 to 1,000 milliwatts average power. The frequency meter is direct reading within 25 megacycles and within 4 megacycles with correction chart; commercial equivalent of TS-230 B/AP.

TS-33/AP X Band Frequency Meter, 8,700 to 9,500 megacycles.—$150.00.

TS-62/AP X Band Echo Box.—$150.00.

TS-110/AP S Band Echo Box.—$150.00.

TS-89 Voltage Divider.—$30.00.

TS-12/AP (Unit 2) X Band slotted line with adapters and probes—$175.00.

TS-100 Synchroscope.

T-85/APT-5, 300-1,600 megacycles Noise Modulated Transmitter, 40 watts C. W.

Waveguide Below Cut-Off Attenuator I. 101-A. U. H. F. Connectors at each end calibration 30-100 db.—$25.00.

Amplifier Strip AM-SSA/SPR-2 contains I. F. amplifier, detector, video amplifier, pulse stretcher and audio amplifier and Rectifier Power Unit PP-155A/SPR-2 bandwidth 10 megacycles, center frequency 30 megacycles, sensitivity 50 microvolts for 10 milliwatts output. Power supply 80/115 V ac. 60-2, 600 cps 1.3 amps. Send for schematic—$65.00 less tubes.

Tuning Units for APR-4 Receiver

TN 16	30- 80 megacycles	TN 18	300-1,000 megacycles
TN 17	80-300 megacycles	TN 19	1,000-2,200 megacycles
		TN 54	2,200-4,000 megacycles

ELECTRO IMPULSE LABORATORY
62 White Street Red Bank 6-0404 Red Bank, N. J.

ELECTRONIC TUBE-MAKING MACHINERY

For manufacturing radio tubes, electronic tubes, cathode-ray tubes, lamps. New and used. Reasonably priced, satisfaction guaranteed.

AMERICAN ELECTRICAL SALES CO.
67 E. 8th St. New York, N. Y.

SHEET METAL MACHINERY

NEW & USED—COMPLETE LINE OF
Box Brakes, Press Brakes, Notchers, Shears, Punches, Rolls, Spot Welders — Di-Acro, Pexto, Whitney Equipment, etc.

B.D. BROOKS, INC. 361 Atlantic Ave
Boston, Mass. Tel. HAncock 6-5200

Wholesale Dealers
IN GOVERNMENT SURPLUS
- electronic components,
- units, wire, etc.

LAPIROW BROS.
1649 Heffner St. Cincinnati 23, Ohio
Kirby 1285

M COPLIN CHRISTIE
RECTIFIERS

Model MH-25.....List Price $215.00
NEW CONDITION—ORIGINAL PACKAGING

Input — 230 Volts 3 ϕ AC. Output — 24-28 Volts 25 AMPS DC: continuous Fan cooled: 2% ripple. Heavy duty —copper sulphide type

$75.00
13" x 13" x 19"
85 Lbs.

LEO SAGAL CO.
860 Glenmont Ave.,
Los Angeles 24, Calif.

RCA Sound Powered Head & chest set $7.75
RBM Col2 VOH DC Solenoid starting relay part No. B-211905-S SPST 100 AMP.....75¢
Heinemann Circuit Breaker 24 VOC 110 AMP., curve 2, #1510 FN-110.....95¢
G.E. Calrod Heaters #4A419, 230 V, 750 W, 1500° Fahrenheit .....$2.00 each
Navy-type 110 VAC "cow gong" Bell $8.75

WANTED

WE NEED YOUR SURPLUS ELECTRONIC COMPONENTS OR EQUIPMENT

WE PAY TOP $$$$$$ FOR:

Radio Components	Wire & Cable
Instruments	Selsyns or Synchros
Relays	Autosyns
Tubes	Motors or Generators
Signal Corps Equipment	Transformers, Air Cooled
Receivers	Test Equipment
Transmitters	
Television Components	

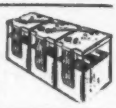
Kindly send us your listing of materials available with lowest price and condition or place our name on your mailing list to receive any listings you may issue.

TECHNICAL MATERIALS COMPANY
104 Pearl Street Boston 10, Mass.

WILLARD 2-VOLT STORAGE BATTERY
20 Ampere-Hours

Exact replacement for GE portables for LB-500—BRAND NEW. Each **$2.69**

WILLARD MIDGET 6-V STORAGE BATTERY



3 amp hour rating. Transparent plastic case. Brand new. 3¾" x 1-13/16" x 2⅝" high. Uses standard electrolyte. Each **$2.85**

ONE-QUART BOTTLE BATTERY ELECTROLYTE

Made by Willard, for above storage batteries. 1 quart sufficient for two 2-volt cells. Hermetically sealed. SPECIAL. per qt. bottle..... **$1.69**

7-PRONG 2-VOLT RADIO VIBRATOR

for Portable and Farm Sets Replacement for GE LB 530 ..... **$1.95**

TREMENDOUS VALUES IN
TRANSMITTING TUBES

ALL BRAND NEW — JAN TYPES

2C-34	$.75	815	$2.25
10Y	.45	826	.75
45 Spec	.35	841/VT51	.45
371A	.75	864	.35
371B/VT166	.75	CK1005	.57
554	.28	1625	.39
559	.95	1626	.39
705A	2.25	1630	.75
800	.95	7193	.65
		8020	1.25

Please include 25% Deposit with order—Balance C.O.D. MINIMUM ORDER $3.00. All Shipments F.O.B. Our Warehouse N.Y.C.

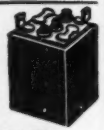
GENUINE MAJESTIC
G & G RADIO PARTS SERVICE
53 VESEY STREET - NEW YORK 7, N.Y.

TERRIFIC VALUE
24-VOLT STORAGE BATTERY, BRAND NEW
17 AMP. HRS.

Made by Delco and Gould. 12 cells, heavy duty, very rugged. Shipped dry, uses standard sulphuric acid electrolyte.
VERY SPECIAL **$22.95**

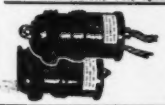
GOULD 6-VOLT STORAGE BATTERY

Navy Standard. Black Rubber Case. BRAND NEW. 15 Amp. Hour Rating **$7.95**



4 VOLT NAVY STORAGE BATTERY

40 amp. hrs. @ 16 hr rate. Plastic case, housed in crackle finished metal case. Brand New. Very special..... **$7.95**



SELSYN 2J1G1

Operates from 57½ V 100 cycles. Suggested wiring for 110 V 60 cycle included. New, tested.
Price per pair **$6.25**

LOOKING for a can to put it in??

ALUMINUM & ZINC IF etc. CANS AVAILABLE

*1" x 2" x 2"H 5.00	*2" x 2½ x 2½"H 5.00
*1⅝ x 1⅝ x 2"H ..... .25	*1⅝ x 1⅝ x 2½"H ..... .27
*1 7/16 x 1 15/16 x 2¾"H .. .26	*2" x 2" x 3¾"H ..... .10
**2⅛ x 2⅛ x 3¾"H ..... .06	**2" x 2" x 1⅝"H ..... .06
**12/16 dia. X1 ..... .06	*1 dia. x 4¼ H ..... .12
*2½ dia. x 2½ ..... .08	*2" x 2½ x 2"H ..... .39

RELAY SPECIALS

Type	Ord No	Contacts	Features	PRICE
Sigma 4F	8500	SPDT	1 ma plate	$2.95
Sigma 5	66 (2)	SPDT	3-24 VDC	2.45
1/inch 1077RF	100	DPDT	ANTENNA TYPE	2.45
Clare Type C	400	DPST	make/11V	1.25
Clare Type	1500	DPDT	5 ma plate	1.85
Allied FID	45	8PNO	4 VDC MINI.	.75
Allied BN	900	4PDT	10 AMP. CONT.	3.25
Allied Bo	14	8PDT	6 VDC 10 A CONT	2.15

Rotary Relay, 14 v sneration/remote model trains, etc. 2.45
Kliton Type ER Thermal Relay, 110/220VAC. 1.35
1 RPM 110 V 60 cy Instrument Motor, Hi Gear Ratio. 7.95
P W H Mini Selenium rect. 18 ma 115 vac in .49
G.E. THYRITE voltage regulator 2rd harmonic generator, 5-40 ma @ 21-33 volts, pkg of 5 1.49
TERMINAL STRIP, 6 term. hi. volt. barrier .29
FILTER CHOKE, 4 hy. 100 ma. 60 ohm cased 1.15
PP INPUT TRANSFormer, pri:Z 8K-15K, sec:Z 100K, 20-300 cy 12H cased. Perfect, suitable servo
FILAMENT TRANSFORMER, 115V pri. 6.3/12 A 1.45
AUTO TRANSFORMER, 115/68/82 volt @ 1½ A 2.95
W.E. Varistor type D-163139 .85
HWH METER, 3 amp 115 volt AC, used cond. 3.95
TUBE SPECIAL, Type 3D21A, 6000 available 1.75
LINE FILTER HF 1A, 100 amp. 2d VDC .75
SELENIUM RECT. FWB 90 VAC in 150 ma 1.45

OIL CAPACITORS

4 MF/800 VDC TLAD type	$1.35	4 MF/600 VDC TJ type	$1.45
6 MF/800 VDC TJ type	2.65	10 MF/600 VDC TJ type	4.75
15 MF/800 VDC TJ type	8.95	20 MF/600 VDC TJ type	9.75

SPECIAL NOISE SUPPRESSION CAPACITORS

CA-442 CA-445 CA-491 CA-209 CA-278
CA-177A CA-196

MANY OTHER TYPES STOCKED INQUIRIES INVITED — COAXIAL RF CONNECTORS

STOCK	DELIVERY	NEW MERCHANDISE	
UG-21B/U	$1.00	WG-58A/U	$1.00
UG-22B/U	1.30	UG-89/U	1.00
UG-58/U	.75	PL-574	1.65
PL-259A	.60	OTHER TYPES AVAILABLE	
UG-290/U	$1.00		
UG-260/U	.85		
PL-258	.75		

TRANSFORMER LAMINATIONS, P-12 MUMETAL .014 ga.
TRANSFORMER LAMINATIONS, UI-312 47-50 .020 ga. $1.35
TRANSFORMER LAMINATIONS, L-12 SILICON .35

ELECTRONIC SPECIALTY SUPPLY CO.
56 Lispenard Street New York 13, N. Y.
BARCLAY 7-2685

TELEPHONE RELAYS

Large Stock of
CLARE, TYPES C, D & E
COOKE, AUTOMATIC—ELECTRIC
ALL TYPES of COILS and PILE-UPS

Send Us Your Specs. for Our Quote

Clare Type C Standard Size Sensitive Telephone Relays

	Coil	Contacts	Will Close At	Price
1)	6500 ohms	1C	2.8 MA	$2.75 ea.
2)	6500 ohms	1-B-1C	3.2 MA	2.75 ea.
3)	6500 ohms	2A	4.8 MA	1.80 ea.
4)	6500 ohms	3A-1B	4.8 MA	1.80 ea.
5)	6500 ohms	1C	1.5 MA	3.25 ea.

Clare Type G Half Size Sensitive Telephone Relays

1)	6500 ohms	2A	5 MA	$2.50 ea.
2)	5800 ohms	3A	5 MA	2.50 ea.
3)	5800 ohms	2B-1C	5 MA	2.50 ea.
4)	4850 ohms	1C	1.5 MA	2.50 ea.
5)	3600 ohms	1C	6MA	2.00 ea.

All above Relays may be used for continuous duty operation on 110V, D.C.

Other Type G Telephone Relays

1)	1300 ohms	1A-1C	24 or 48V.	2.50 ea.
2)	700 ohms	2A-1C	24V.	2.50 ea.

G. E. Relays #CR 2791-B109P36 Coil—10,000 ohms Contacts-1A, 1B Operates on 8 MA. **Price—$1.65**

Signal Wheelock Relays #KS9665 Coil—2,000 ohms Contacts-1A, 1B, 1C Operates at 9 MA. **Price—$2.75 ea**

SIGMA SENSITIVE RELAYS

Type 5KJ, Hermetically sealed coil—10,000 ohms. Contacts—S.P.D.T. Closes at 0.5 Milliamps. Price ..... **$8.50 ea.**

Legend (A) Normally open set of contacts.
(B) Normally closed set of contacts.
(C) Single pole double throw set of contacts.
MA = Milliamps.

Chase Electronics Supply Co.
222 Fulton St.
New York 7, N. Y.
HOllis 4-5033
Digby 4-3088

SEARCH RECEIVER — ARD-2

Frequency range 80 to 3000 Mcs.

Measures RF signals from 80 to 3000 Mcs and pulse rates from 50 to 8000 cycles.
The ARD-2 can be used as a Direction Finder to locate signals, or as a frequency meter, by VISUAL and AURAL indicators, provide Originally designed and used by USN aircraft. Ideally suited for military, laboratory and general purpose use.
Equipment consists of the following:
Antenna Detector-CMD-66AFH — Has variable length antennas, diode detector and silver plated tuning stub with calibrated scale.
AMPLIFIER CMD-50ADC—has three stage pulse amplifier, a trigger circuit, a pulse rate counter circuit and audio amplifier, visual signal indicator, rectifier power supply which is operative on 115 Volts AC 60 to 2400 cycles current, regulated.
Test OSCILLATOR-CMD-60ABG — Has cavity frequency of 400 cycles with selection of four pulse repetition rates.
ALL CABLES AND FITTINGS, ACCESSORIES AND SHOCK MOUNTED RACK for immediate instalation, plus two Technical Manuals.
SPARE PARTS—Steel chest includes spares for components and two extra sets spare tubes.
Guaranteed NEW
All the above in original export packed cases. Wt.: 113 lbs
Price each $225.00

Other selected equipment for Radio Communications in our stocks.

Communication Devices Co.
2331 Twelfth Ave. NYC 27, N. Y.
Cable: Communidev Tel: Ad 4-6174

CONDENSERS
OUR SPECIALTY
OIL FILLED & TRANSMITTING MICA TYPES
All Values and Voltage Ratings
We Invite Your Inquiries
TECHNICAL RADIO PARTS CO.
557 McDonald Ave., Brooklyn 18, N. Y.

WESTINGHOUSE HIPERSIL CORES

Quantity	Gauge	Strip Width	Build Up	Window Width	Window Height
2,000	.003	1⅛	½	7/16	3
700	.003	⅜	⅜	7/16	3

Available for immediate delivery

RAYTHEON MFG. CO.
Surplus Sales Dept. Waltham, Mass.
Tel. Waltham 5-5860—Ext. 2602

CK-542-DX
VACUUM TUBES
Very Special Price

An oversupply of sub-miniature CK-542-DX Vacuum tubes makes this offer possible for a limited time only.

Write today for further information to R. H. Matson, E-905 1st National Bank Bldg., St. Paul 1, Minnesota.

IF THERE IS
Anything you want
that other readers of this paper can supply
OR—
Something you don't want
that other readers can use, advertise it in the
SEARCHLIGHT SECTION

ATTENTION! TELETYPE BUYERS

RADIOTELETYPE TERMINAL EQUIPMENT

WESTERN ELECTRIC AN/FGC-1 voice frequency carrier teletype equipment for use as single-channel two-tone space diversity radioteletype receiving terminal. Associated radio receivers (see below) invert incoming signals to a frequency of 2125 cycles for the "closed" condition and 2975 cycles for the "open" condition of the sending contacts. The AN/FGC-1 equipment rectifies these signals to d-c telegraph signals for operation of teletype-writer equipment at a signal center. Contains spare fuse mounting and terminal strips, space for automatic frequency control unit, frequency indicator panel, jackstrip, receiver relay panel, detector B, detector A, current limiter B, current limiter A, fuses, rectifier XXXIX-61680-B, rectifier KS-5844 List 01, alarm and miscellaneous equipment, and outlet and heater box. Made by Western Electric Co. per Bell Lab. Spec #X061789-A List 1. Input power 160 VA at 115 v, 50/60 cycles, one phase. Mounted in rack cabinet with hinged front door, 23 x 17" x 84". Net weight 425 lbs. Brand new in original export packing, dry storage. Shipping weight 635 lbs., 89 cu. ft. **PRICE ON REQUEST.**

AN/FRR-3 (PRESS WIRELESS #2107K) Radioteletype dual diversity receiver to feed AN/FGC-1 (above) or any other radio teletype terminal equipment. Contains two 11 tube superhet receivers with one 10 tube high frequency BFO oscillator panel. Five preset crystal controlled channels, frequency range 2.4 to 23 mc., motor-driven band switching, local or remote control. Receives A1, A2 or A3 emission. Output dual balanced 500 ohm line. Antennas may be two rhombics or double doublets. Input power 400 watts at 110 or 220 v., one phase, 50/60 cycles. In steel cabinet, 84" high by 22½" wide by 17" deep. Net weight 650 lbs. Export packed, shipping weight 1175 lbs., 55 cu. ft. **PRICE ON REQUEST.**

MODEL #14 TAPE PRINTERS. MODEL #14 TYPING REPERFORATORS. MODEL #15 PAGE PRINTERS. MODEL #28 PAGE PRINTERS. PRICES ON REQUEST.

RADIATING TOWER BASE INSULATORS

BLAW-KNOX #10 is a 125 foot radiating tower supported by four corner insulators. These insulators not only provide mechanical support for great weight involved but also prevent high-voltage leakage in any weather. These insulators may also be adapted to support a single vertical radiator. For example, a 60 to 70 foot aluminum tubing radiator can be guyed with strain insulators and manila rope and used as low frequency air navigation markers, or will replace and out-perform long and cumbersome communications antennas. **BRAND NEW, ORIGINAL EXPORT PACK.** $17.50

GENERATOR BARGAIN

GN-39-F, High-efficiency compound-wound DC generator. Continuous duty output rating is 14.6 volts at 25 amps. and 1000 volts at 350 ma. Has shaft extension for gas engine or electric motor drive. Requires 1½ HP at 2800 RPM. Originally designed to supply AR power for BC-191 500 chmtr. and will replace RA-34 rectifier. **BRAND NEW. EXPORT PACKED** $45.00

OIL FILLED CAPACITORS

0.25 mfd/15000 v #15020	$17.50
0.25 mfd/20000 v #14F64	27.50
0.25 mfd/30000 v #TK20002	24.50
0.3 mfd/12500 v	27.50
1.0 mfd/10000 v #1081007B	27.50
1-1 mfd/7500 v #7529	27.50

G. L. ELECTRONICS

905 S. Vermont Ave., Los Angeles 6, Cal.

Calif. Buyers add Sales Tax

Westinghouse ELAPSED TIME METERS $15.50

General Electric Round Case Smaller Numerals $11.50

Genuine TELECHRON Motors

2 RPM $2.00
3 RPM 3.50
3.6 RPM 3.15
1 RPM 3.95
60 RPM 4.50

One of each $15.00

ZENITH 1951 TV Remote Control Motor Units

Reversing control switch at end of 17 foot cable. Powerful 4 RPM clutch motor.

Will drive anything

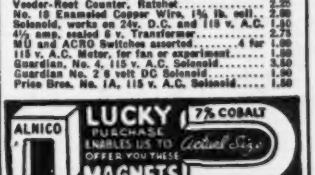
Can be used for door opener, window raiser, model RR turntable. Complete with transformer. **$12.90** 6 for $70.00

MARKTIME 5 HOUR SWITCH

A 10 amp. timing device. Pointer moves back to zero after time elapses. Ideal for shutting off radios and TV sets when you go to bed. Limited supply at this special PRICE... **$4.90**

Also available in 15 min., 30 min., 1 hr. at $3.90

Veeder-Root Counter, Rotary	$ .90
Veeder-Root Counter, Ratchet	2.25
No. 18 Enamaled Copper Wire, 1¼ lb. coil	2.00
Solenoid, works on 24v, D.C. and 110 v. A.C.	1.40
4½ amp. sealed 6 v. Transformer	2.75
MU and ACRO Switches assorted	4 for 1.00
115 v. A.C. Motor, for fan or experiment	1.50
Guardian, No. 4, 115 v. A.C. Solenoid	3.50
Guardian No. 2 6 volt DC Solenoid	1.90
Price Bros. No. 1A, 115 v. A.C. Solenoid	1.50

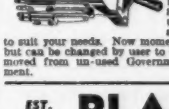


Eby bakelite Binding Posts	.12
TELETYPE 1/40 H.P. 110 v. D.C. Motor	2.90
Arrow-H & H. DPDT Toggle Switch	.65
C/H Off center, SPDT Toggle Switch	.35

ANTENNA ROTATOR or DOOR OPENER

Geared down 24v. universal motor with transformer **$7.50**

GE Argon Glow Lamps ..... 4 for $1.00
100 for $20.00



Mossman Lever Switch $1.50

10 Amp. Heavy Duty Silver Contacts. Contacts can easily be restocked and changed to suit your needs. Now momentary OFF CENTER but can be changed by user to stay either side. Removed from un-used Government Surplus Equipment.

EST. 1923 **BLAN** EST. 1923

64 Dey St. New York 7, N. Y.

TUBES

Here is only a partial listing of our large stocks of Nationally Advertised Brands.

We guarantee all tubes. Compare our Prices. We endeavor to give you low, low prices, consistent with quality merchandise and service.

0A2	$1.00	12-E	1.45	829-B	$3.90
0B2	1.10	12AT7	.95	832-A	9.75
0Z4-A	.65	15-TG	3.00	833-A	39.95
1B22	2.25	15-T. ION	4.00	837	1.50
1B25	8.00	101D	1.25	872-A	1.50
1B26	2.50	101-F(WE)	1.25	872-A (GE)	3.50
1B27	15.00	101-L(WE)	1.25	992-R	175.00
1L4 (G.E.)	4.90	102-D(WE)	1.25	954	.27
1N21	.85	102-F(WE)	1.25	955	.40
1N21B	3.50	102L(WE)	1.25	956	.37
1N23	1.45	104-D(WE)	1.25	958-A	.65
1N23A	2.50	211	.85	1613	.90
1N23B	3.75	242-C	4.00	1616	.75
1N34	.65	274-B(WE)	1.50	1622	2.50
1P24	1.60	275-A(WE)	4.50	1625	.49
2E24	4.50	310-A(WE)	6.50	1628	.49
2E26	1.25	311-A(WE)	6.50	1629	.39
2E30	2.15	313-C(WE)	1.25	1631	.75
2J52	35.00	350-B(WE)	2.50	2050	1.40
2K25	25.00	357-A(WE)	2.50	2050A	1.60
2K45 "WRITE"		372-A(WE)	5.00	5636-A	5.00
3AP1	10.75	374-A(WE)	2.50	5636-B	6.95
3B24	4.20	387-A(WE)	2.50	5656	3.95
3BP1	7.25	408-A(WE)	2.50	5670	.75
3BP1A	10.90	445-B/5881	2.95	5810	.75
3C23	5.75	487-A(WE)	7.25	5816/1B3	.85
3DP1-A	5.95	498-A(WE)	3.00	5834	.44
3S4	.90	500	1.25	5836	1.50
4X-150-A	39.50	700-A, B, C, or D	20.00	5836	.44
5D21	13.95	703-A	3.95	304-TH	9.95
5FP7	1.95	705-A	3.95	805-TL	1.95
5J23	18.00	705-B	5.00	C6L	15.00
5LP7	15.75	707-B	11.00	F-321A	7.95
5V4-G	1.10	713 (WE)	1.00	FG-17	4.75
6AJ5	1.25	715-A	6.00	RK-28-A	8.00
6AK5	.95	715-B	9.00	RK-34	.27
6AN5	2.95	715-C	22.95	RK-47	5.00
6AS7-G	3.45	725-A	6.95	RK-59	.75
6BQ6GT	.90	807 or 807-A	1.65	RKR-72	1.25
6C4	.65	812	2.75	VR-105	.48
6J6	.95	813	7.85	VR-150	.55
6J6-V	.45	814 (G.E.)	3.50	KU-576	25.00

CALL OR WRITE FOR OTHER RECEIVING, TV, INDUSTRIAL, DIODE, & WESTINGHOUSE TYPE QUOTATIONS.

• SELENIUM RECTIFIERS

Full-Wave Bridge Types

Current (cont.)	18/14 Volts	36/28 Volts	54/40 Volts	130/100 Volts
1 Amp.		$1.98		
2 Amps.	$2.40	3.75	$6.95	$10.50
4 Amps.	3.85	7.00	9.00	13.00 (2) A.)
6 Amps.	5.65	9.00	.....	15.00
10 Amps.	6.55	10.95	.....	48.00
12 Amps.	7.50	14.00	.....	58.00
20 Amps.	13.25	26.50	.....	.....
24 Amps.	14.95	28.00	.....	.....
30 Amps.	19.00	36.00	.....	.....
36 Amps.	25.50	35.00	.....	.....

All our Rectifiers are now & Guaranteed one year. We manufacture special types of rectifiers and rectifier supplies to your specs . . . FAST DELIVERY AND LOW PRICES on Small and Large Quantities.

• Selenium Rectifier Transformers

Pri: 110 V, 60 cycle in.
Sec: 18, 24, and 36 volts.
{ 4 amps. $ 8.75
{ 12 amps. $16.75
{ 24 amps. $35.75

Designed for bridge or center-tap use. These transformers are not surplus, but are made to our specs by a leading m'fr.

- **110V. Pri—36V. 50 amp second XFMR...$39.95**
- **115V. Pri—6 Volt. 190 Amp Secondary Xformers $75.00**
- **110V. Selenium Rectifier Specials**
  ½ wave..... 65 ma.....only 89¢ ea.
  ½ wave..... 450 ma.....only $1.65 ea.
- **Carter, 6 V. Dynamotors, in orig. Factory Cartons.—400 VDC @ 375 ma**
  List Price $71.40—Special $28.00
- **ART-1—Compact, New, Aircraft 3105 KC. Transmitter—6" x 6"—Complete.....@ $25.00**
- **The AR-11, 35 Watt Transmitter and Superhet Recvr. Complete with 110 and/or 220 V.A.C. pwr. supply—With all Accessories. New: Export packed.**
- **Weston Meters. Model 606 0-100 micro amps. New, Boxed ..... @ $5.95**
- **Complete Line of Aluminum & Steel Relay Panels, Chassis, Brackets, Etc.—Write.**
- **115 Volt—300 Watts A.C. Compact Gas—Generator—Export Packed $165.00**

Terms: FOB-NYC—25% Deposit with order—or send full remittance to save COD charges—Rated Firms (D.&B.) Net 10 days — All merchandise guaranteed. Wherever possible, extend D.O.

***Phone:* REctor 2-2563**

***Cable:* Barryject, N. Y.**

BARRY ELECTRONICS CORP.

136 Liberty Street New York 6, N. Y.

Look! Been Searching for this item?

Brand New OUTPUT TRANSFORMER
ES-501027
Used in SCR-274 & other aircraft receivers
SUITABLE FOR USE IN NEW DESIGNS
MANUFACTURING QUANTITIES AVAILABLE

Electrical specifications:
Plate winding/power pentode
Sec.-high & low imped. headphones
HAS MOUNTING FOR NEON NOISE SUPPRESSOR

ALSO AVAILABLE NEW MFR. RADIO TELETYPE Selective Audio Filters. set of 4 $23.75

MODULATION PRODUCTS COMPANY
56 Lispenard St. Barclay 7-2684 New York 13, N.Y.

Portable Instruments

Molded Bakelite case 7" x 4½" x 3"

D.C. MICROAMMETERS
5..10..50 microamperes

THERMOCOUPLE MILLIAMMETERS
1, 5..5..10 milliamperes

THERMOCOUPLE VOLTMETERS
5 to 500 volts

Available in multiple range combinations

Precision Electrical Instrument Co.
146 Grand Street New York 13, N. Y.

-CONNECTORS-

AN
"3100"
"3101"
"3102"
"3106"
"3108"

Black and Mellomyne Inserts in Stock

101 & 102 A & B Shell Types In Stock

Catalog On Request **CLAMP—ALL SIZES**

FOR TYPES AVAILABLE SEE ELECTRONICS BUYER'S GUIDE

QUICK SERVICE OUR SPECIALTY

WILGREEN INDUSTRIES

99 Murray St., New York 7, N. Y.

For Immediate Delivery

Tels. WOrth 2-7423-4-5 WOrth 4-2490-1-2

SPECIAL Purpose Tubes all New & Jans.

CE1C	2.25	954	.55
C6J	5.95	955	.80
F123A	7.75	957	.55
F127A	17.75	958A	.65
HK72	1.50	1005	.75
VR105	1.45	1616	.90
1B20	4.75	1619	.29
2X3	.65	1625	.45
3A4	.85	1626	.45
3B24	4.75	1629	.45
6AG6	2.75	1641	2.25
10	.45	2051	1.10
211	.50	9002	.90
310A	6.75	9003	1.75
813	7.75	9004	.65
814	3.25	9005	1.75
815	1.75	9006	.45

Crystal Diodes All Guaranteed

1N21B	3.25	1N23B	3.75
1N23	1.45	1N26	7.75
1N23A	2.75	1N34A	.95

Query us on any type of Tubes.

ALLIED ELECTRONIC SALES

136 Liberty Street New York, N. Y.

Phone COrtlandt 7-4320

STROMBERG-CARLSON AMPLIFIER

50 watt Power Amplifier—Stromberg-Carlson #22 complete with tubes and panel for 19" rack mounting.....$62.50 FOB Buffalo N. Y. Id 5450

Larkin Electronic Supply Co. Inc.

129 W. Huron Street, Buffalo 1, New York

WANTED

WANTED

YOUR SPARE SURPLUS EQUIPMENT

DYNAMOTORS • SELSYNS • AUTOSYNS • INVERTERS • TRANSMITTERS

RECEIVERS • TEST EQUIPMENT

Please send list stating condition and lowest price.

No Quantity Too Small or Too Large!

C & H SALES COMPANY

BOX 356-SE EAST PASADENA STATION • PASADENA 8, CALIFORNIA

WANTED

QUARTZ CRYSTAL UNITS

in holders, FT-171; FT-241; FT-243; FT-500. Any quantity. Advise condition.

W-2317, Electronics
330 W. 42 St., New York 18, N. Y.

COLUMBIA ELECTRONICS LTD.

EQUIPMENT WANTED!

NOTE NEW ADDRESS BELOW

We want to buy all types of surplus electronic equipment. We are one of the largest buyers in U. S. We buy more because we give every seller top prices and a fair deal. TELL US WHAT YOU HAVE. USE COUPON BELOW—*AND MAIL TODAY!*

Use following numbers to indicate conditions: N-1, brand new; N-2, used, like new; N-3, used.

ITEM	CONDITION	PRICE WANTED

To: COLUMBIA ELECTRONICS LTD., 7460 N. Varna Ave., N. Hollywood, Calif.

Name .....

Address .....

SEE COLUMBIA ELECTRONICS AD ON PAGE 454

WILL PAY $50.00 each for

CU-25/ART-13 Loading Units
DY-12/ART-13 Power Supplies

AIR TRANSPORT SERVICE

Montreal Airport Dorval, Que., Can.

WE JUST GOTTA BUY THIS STUFF!

We're tearing our hair out to buy desperately needed equipment, such as ART-13, BC-348, BC-224, BC-342, BC-312, ARC-1, BC-221, R5/ARN-7 or components. In fact, we'll buy any parts or accessories no matter how small. For speedy, efficient service and a real honest deal, phone, wire or write:

V & H RADIO & ELECTRONICS SUPPLY CO.
2033 W. Venice Blvd., Los Angeles 6, Calif.
Telephone: REpublic 3-1127

WANTED URGENTLY

Silicon Steel,
Hypersil or Armco Trans-Cor 2X,

3X, 3W or 4W in .012 or .014 coil stock up to 40" wide.

W-3354, Electronics
330 W. 42 St., New York 36, N. Y.

WANTED

AMPLIFIERS

WECO. #108A, WECO. #91A, Operadio #1147A, Mills Industrial MW-1661, RCA BA-2C, RCA BA-13A, BC-1388-A-B.

W-3302, Electronics
330 W. 42 St., New York 36, N. Y.

PRECISION RESISTORS

Over 2½ Million in Stock

-TAB —Specialists in Precision Resistors No Mfrs Choice— We ship Types in Stock

9.31Ω	22Ω	133Ω	332Ω	1650Ω	11000Ω
9.43	27Ω	150Ω	340Ω	1667	11667
9.53	30Ω	154	357	1700	11800
9.607	33Ω	160	360	1714	11917
9.7	36Ω	165	375	1750	12000
9.87	39Ω	170	390	1777	12500
9.93	43Ω	175	400	1800	13000
9.97	47Ω	180	412	1818	13333
10Ω	50Ω	187	420	1875	13500
10.1	51Ω	190	430	1900	14000
10.2	56Ω	200	440	1909	14286
10.3	60Ω	205	450	1923	14500
10.4	62Ω	210	460	1935	15000
10.5	68Ω	220	470	1944	15385
10.6	70Ω	225	475	1950	15500
10.7	75Ω	230	480	1960	15714
10.8	80Ω	235	490	1970	16000
10.9	82Ω	240	500	1980	16500
11Ω	85Ω	250	510	2000	17000
11.1	90Ω	260	520	2020	17500
11.2	91Ω	270	530	2050	18000
11.3	100Ω	275	540	2100	18333
11.4	105Ω	280	550	2143	18500
11.5	110Ω	285	560	2200	19000
11.6	115Ω	290	570	2250	19500
11.7	120Ω	300	580	2300	20000
11.8	125Ω	320	600	2400	21000
11.9	130Ω	330	625	2500	22000
12Ω	135Ω	340	650	2600	23000
12.1	140Ω	350	667	2667	24000
12.2	145Ω	360	675	2700	25000
12.3	150Ω	370	680	2800	26000
12.4	155Ω	375	700	2857	27000
12.5	160Ω	380	714	2900	28000
12.6	165Ω	390	720	3000	29000
12.7	170Ω	400	730	3077	30000
12.8	175Ω	410	740	3200	31000
12.9	180Ω	420	750	3300	32000
13Ω	185Ω	425	760	3333	33000
13.1	190Ω	430	770	3400	34000
13.2	195Ω	440	780	3500	35000
13.3	200Ω	450	790	3600	36000
13.4	205Ω	460	800	3636	37000
13.5	210Ω	470	810	3700	38000
13.6	215Ω	475	820	3750	39000
13.7	220Ω	480	825	3800	40000
13.8	225Ω	490	830	3900	41000
13.9	230Ω	500	840	4000	42000
14Ω	235Ω	510	850	4100	43000
14.1	240Ω	520	860	4200	44000
14.2	245Ω	530	870	4300	45000
14.3	250Ω	540	880	4400	46000
14.4	255Ω	550	890	4500	47000
14.5	260Ω	560	900	4600	48000
14.6	265Ω	570	910	4700	49000
14.7	270Ω	580	920	4800	50000
14.8	275Ω	590	930	4900	51000
14.9	280Ω	600	940	5000	52000
15Ω	285Ω	610	950	5100	53000
15.1	290Ω	620	960	5200	54000
15.2	295Ω	630	970	5300	55000
15.3	300Ω	640	980	5400	56000
15.4	305Ω	650	990	5500	57000
15.5	310Ω	660	1000	5600	58000
15.6	315Ω	670	1010	5700	59000
15.7	320Ω	680	1020	5800	60000
15.8	325Ω	690	1030	5900	61000
15.9	330Ω	700	1040	6000	62000
16Ω	335Ω	710	1050	6100	63000
16.1	340Ω	720	1060	6200	64000
16.2	345Ω	730	1070	6300	65000
16.3	350Ω	740	1080	6400	66000
16.4	355Ω	750	1090	6500	67000
16.5	360Ω	760	1100	6600	68000
16.6	365Ω	770	1110	6700	69000
16.7	370Ω	780	1120	6800	70000
16.8	375Ω	790	1130	6900	71000
16.9	380Ω	800	1140	7000	72000
17Ω	385Ω	810	1150	7100	73000
17.1	390Ω	820	1160	7200	74000
17.2	395Ω	830	1170	7300	75000
17.3	400Ω	840	1180	7400	76000
17.4	405Ω	850	1190	7500	77000
17.5	410Ω	860	1200	7600	78000
17.6	415Ω	870	1210	7700	79000
17.7	420Ω	880	1220	7800	80000
17.8	425Ω	890	1230	7900	81000
17.9	430Ω	900	1240	8000	82000
18Ω	435Ω	910	1250	8100	83000
18.1	440Ω	920	1260	8200	84000
18.2	445Ω	930	1270	8300	85000
18.3	450Ω	940	1280	8400	86000
18.4	455Ω	950	1290	8500	87000
18.5	460Ω	960	1300	8600	88000
18.6	465Ω	970	1310	8700	89000
18.7	470Ω	980	1320	8800	90000
18.8	475Ω	990	1330	8900	91000
18.9	480Ω	1000	1340	9000	92000
19Ω	485Ω	1010	1350	9100	93000
19.1	490Ω	1020	1360	9200	94000
19.2	495Ω	1030	1370	9300	95000
19.3	500Ω	1040	1380	9400	96000
19.4	505Ω	1050	1390	9500	97000
19.5	510Ω	1060	1400	9600	98000
19.6	515Ω	1070	1410	9700	99000
19.7	520Ω	1080	1420	9800	100000
19.8	525Ω	1090	1430	9900	
19.9	530Ω	1100	1440	10000	
20Ω	535Ω	1110	1450	10500	
20.1	540Ω	1120	1460	11000	
20.2	545Ω	1130	1470	11500	
20.3	550Ω	1140	1480	12000	
20.4	555Ω	1150	1490	12500	
20.5	560Ω	1160	1500	13000	
20.6	565Ω	1170	1510	13500	
20.7	570Ω	1180	1520	14000	
20.8	575Ω	1190	1530	14500	
20.9	580Ω	1200	1540	15000	
21Ω	585Ω	1210	1550	15500	
21.1	590Ω	1220	1560	16000	
21.2	595Ω	1230	1570	16500	
21.3	600Ω	1240	1580	17000	
21.4	605Ω	1250	1590	17500	
21.5	610Ω	1260	1600	18000	
21.6	615Ω	1270	1610	18500	
21.7	620Ω	1280	1620	19000	
21.8	625Ω	1290	1630	19500	
21.9	630Ω	1300	1640	20000	
22Ω	635Ω	1310	1650	21000	
22.1	640Ω	1320	1667	22000	
22.2	645Ω	1330	1700	23000	
22.3	650Ω	1340	1714	24000	
22.4	655Ω	1350	1750	25000	
22.5	660Ω	1360	1800	26000	
22.6	665Ω	1370	1818	27000	
22.7	670Ω	1380	1875	28000	
22.8	675Ω	1390	1900	29000	
22.9	680Ω	1400	1909	30000	
23Ω	685Ω	1410	1923	31000	
23.1	690Ω	1420	1935	32000	
23.2	695Ω	1430	1944	33000	
23.3	700Ω	1440	1950	34000	
23.4	705Ω	1450	1960	35000	
23.5	710Ω	1460	1970	36000	
23.6	715Ω	1470	1980	37000	
23.7	720Ω	1480	2000	38000	
23.8	725Ω	1490	2020	39000	
23.9	730Ω	1500	2050	40000	
24Ω	735Ω	1510	2100	41000	
24.1	740Ω	1520	2143	42000	
24.2	745Ω	1530	2200	43000	
24.3	750Ω	1540	2250	44000	
24.4	755Ω	1550	2300	45000	
24.5	760Ω	1560	2400	46000	
24.6	765Ω	1570	2500	47000	
24.7	770Ω	1580	2600	48000	
24.8	775Ω	1590	2667	49000	
24.9	780Ω	1600	2700	50000	
25Ω	785Ω	1610	2800	51000	
25.1	790Ω	1620	2857	52000	
25.2	795Ω	1630	2900	53000	
25.3	800Ω	1640	3000	54000	
25.4	805Ω	1650	3077	55000	
25.5	810Ω	1667	3200	56000	
25.6	815Ω	1700	3300	57000	
25.7	820Ω	1714	3333	58000	
25.8	825Ω	1750	3400	59000	
25.9	830Ω	1800	3500	60000	
26Ω	835Ω	1818	3600	61000	
26.1	840Ω	1875	3636	62000	
26.2	845Ω	1900	3700	63000	
26.3	850Ω	1909	3750	64000	
26.4	855Ω	1923	3800	65000	
26.5	860Ω	1935	3900	66000	
26.6	865Ω	1944	4000	67000	
26.7	870Ω	1950	4100	68000	
26.8	875Ω	1960	4200	69000	
26.9	880Ω	1970	4300	70000	
27Ω	885Ω	1980	4400	71000	
27.1	890Ω	2000	4500	72000	
27.2	895Ω	2020	4600	73000	
27.3	900Ω	2050	4667	74000	
27.4	905Ω	2100	4700	75000	
27.5	910Ω	2143	4800	76000	
27.6	915Ω	2200	4900	77000	
27.7	920Ω	2250	5000	78000	
27.8	925Ω	2300	5100	79000	
27.9	930Ω	2400	5200	80000	
28Ω	935Ω	2500	5300	81000	
28.1	940Ω	2600	5400	82000	
28.2	945Ω	2667	5500	83000	
28.3	950Ω	2700	5600	84000	
28.4	955Ω	2800	5700	85000	
28.5	960Ω	2857	5800	86000	
28.6	965Ω	2900	5900	87000	
28.7	970Ω	3000	6000	88000	
28.8	975Ω	3077	6100	89000	
28.9	980Ω	3200	6200	90000	
29Ω	985Ω	3300	6300	91000	
29.1	990Ω	3333	6400	92000	
29.2	995Ω	3400	6500	93000	
29.3	1000Ω	3500	6600	94000	
29.4	1005Ω	3600	6667	95000	
29.5	1010Ω	3636	6700	96000	
29.6	1015Ω	3700	6800	97000	
29.7	1020Ω	3750	6900	98000	
29.8	1025Ω	3800	7000	99000	
29.9	1030Ω	3900	7100	100000	

Any Size Above, Each 35¢: Ten for $3.29

MEGOHMS

1.	1.579	2.7	4.	6.7	10
1.1	1.65	2.75	4.22	7	11.55
1.2	1.74	2.8	4.29	7.5	12.5
1.25	1.8	2.865	4.5	7.62	12.63
1.3	1.9	3	4.7	7.75	13
1.35	2	3.3	5	8	13.85
1.39	2.11	3.4	5.5	8.07	20
1.4	2.2	3.577	6	8.2	
1.5	2.26	3.75	6.4	9.09	
1.57	2.5	3.8	6.5	9.5	

Any Size Above, Each 79¢: Ten for $6.49

Vacuum Precision HiVolt Resistors

Megohms—12/3M/6/7½/8½/9½/1/1.5/2/3/3.75½%
Accy.....Ea. $1/ 10/$7.50

SELENIUM RECTIFIERS

We specialize in Rectifiers and Power supplies to your specifications. Immediate delivery

Current (Cont.)	18/14 volts	30/28 volts	54/40 volts	120/100 volts
1 amp	1.95	3.95		
2 amps	2.98	4.95	6.98	9.95
4 amps	3.65	6.75	8.75	17.50
6 amps	5.65	8.75	14.50	22.50
8 amps	6.50	9.75	16.75	27.50
12 amps	7.98	14.98	25.95	56.00
20 amps	12.75	24.75	47.50	90.00
24 amps	14.00	26.00		
30 amps	18.50	34.50	59.50	179.50
36 amps	25.00	42.50		
48 amps	29.50	52.50	106.50	224.00

C.T. Rect 100 amp 10-6.10V ..... $35.
70 amp 10-6-12V $21.25; 36-8-36V 70 amp $43.50
Full Wave Selen Rect & Trans. with Analog Tests in Kit form, at Fraction of usual price. All 115V/60~ inputs

up to 16VDC at 12 amps..... $25.95
up to 32VDC at 12 amps..... 34.95
up to 32VDC at 48 amps..... 149.50
up to 92VDC at 6 amps..... 12.98
-TAB- famous supply Pak no saving tabs FW Bridge Selen for relays or Pwr. 115 to 130 vac. Outputs 6 vdc/40ma..... Ea. 49¢; 10 for $5.50

STORAGE BATTERIES

2G Volt WILLARD Mid-BRAND NEW! 5 cc. Dessoned Portable Emgie Models..... 10c; 4 for 35¢
2V/2AH Wirlard PLUS 2V Vibrator..... $2.79
6V/4AH Willd NT6/BB214C..... 1.98
6V/10AH Willard Battery Acid, (1-Kart) 1 pt. 89c; 2 pts..... .98
Hydrometer 1.00 to 1.24 Sp Grav..... 2.50
Spec Grav Ind & Meter, Thermom..... 4.98

UHF ANTENNA

UHF ANTENNA 12"/RCH ATA/ ARRI Umbla Olian & Ham Band Ins. Coax Term 50fr Ft Cont Wtd Guide & H ware Mobile Mtg. Hdw. Diec 4 for $2.00
PL-259 for coax..... .49
TV CONICAL ANTENNA (Dual-K) Sturdy Prefab Const. Vermetle 72. 150 or 300 ohm Match. Incl. 8 elements & 160 ft. All Copper Twins Cross Bar & Rd wgn. Brand New, Only..... $6.49
MICROWAVE ANT AS12S/APE 1000 to 3400Mc w/RG/58U Term InBnds HiPass Incl H'ware..... $6.98
Hvy Duty Twinax 300 ohm 4c 1000 ft..... 30.00
ANT ANG300A 12" Wbap..... 1.98
ANT AN131A 13ft. 8 sec..... 3.98

"TAB"
THAT'S A BUY

SELSYNS

2J1G1 GE As Is No Returns..... 2 for 49c
2J1H1 GE Selsyns..... 2 for $6.98
2J1G2E Brand New 115V/400 cy. m.-..... 29.75
C78248 Sync Transf 115V/400 cy..... 2 for $29.95
C78249 Sync. Diff. 115V/60 cy. 15.96 ..... 2 for $21.00
Sync. Trans. C-49405-3 Type 1-1 Brand New
Mfgr. Bendix $27.50..... 2 for $50.
Sync Receiver 115V/60cy Type 11-4 Indiv. Cert.
New $33.95; ..... 2 for $55.
Bendix Antenna AY1&AY2..... 2 for $4.95

6 VOLT INPUT CARTER GENEMOTORS

Brand New Way Below List Price)

Output	Model
400V/375Ma	1m 4037AS Each..... $29.98
500V/150Ma	1m 5019AS Each..... 29.98
500V/200Ma	1m 5025AS Each..... 34.98

All CARTER GENEMOTORS supplied with General-Electric Input Filter FREE!

FRACTIONAL H.P. MOTORS

Hvy Duty 1/40 HP, 1 or 2 PH, 3450 RPM..... $2.49
Same as above slgt defective in case..... 1.49
1/30HP 117/234V 47 to 63 Cy 5/.35A 2600-3100 RPM /Fine Thrd Dia..... 5.98
Motor and Switch Assy 28VDC/6A 2000 RPM Cams Drive 14 Silver Pt. Switch..... 4.98
40 Oz.-In Torque Sync. Inductor **GE 35A6Y 5** 90 M36.75 RPM 115 VAC..... 14.95

END EQUIPMENT BUYS

US Navy Version BC648 Ideal Citizens Band Conversion, NEW, less tubes, connector & dyn..... $12.95
TG5 Keyer, New..... 5.98
R4/ARR7 Recr w/Dynm..... 16.95
TG10 Code Unit, Less Tubes & Cabinet, as is. Good for PA..... 19.95
ART13 Mtch Amp, New, Less Tubes..... 29.95
RM23 Control Unit. BRAND NEW..... 12.95
RT34/ARN5 30 Mc IF Less Tubes, As Is. Good Condition..... 7.98
R65/TRC1 Good, As Is, Less Tubes..... 29.95
E65S Time Interval Signal, Used..... 4.98
R74/CRW Recr, Less Tubes, As Is..... 7.95
I-81 Compass Indicator, Like New..... 7.95
I-82 Compass Indicator, Like New..... 7.95
P67T Pwr Supply Unit, Less Tubes..... 7.95
I-108 Range Calibrator, Metal Case..... 29.98
Hickey 1600L Radio Xmitter, w/Metal Case, Less Vibrapack, As Is..... 2.98
I-198 Sig. Gen. Good Cond, Less Tubes..... 14.95
BC458 Mod. Less Tubes, Dyn, As Is..... 1.98
SCR536 IFF, Less Tubes, As Is..... 1.98
BC402 Front Door for 522, As Is..... 1.98
BC603 Amp, Less Tubes, As Is..... 7.98
BC906 Freq. Mtr, etc, complete..... 29.95
I-122A Sig Gen, 115V/60 Cy..... $145.50
BC221 Freq. Mtr. Cond..... 125.00
SCR522A Less/Xtals w/Tubes..... $ 69.95

DYNAMOTORS

PE 103 in 12V out 500V/180ma..... $29.95
DM81PC in 28V/0.2A out 425V/225ma..... 9.95
DM41A in 28V/1.7A out 175V/135ma..... 2.79
in 12.24V out 500V/50ma..... 1.49
DM32 28V/1.1A out 250V/60ma..... 1.49
BD77R 14V/40V out 1000V/150ma..... 11.98
DM4 12 & 36V, out 225V/100ma, 440V/300ma 11.98
DM35PC /1.45A out 220V/80ma..... 5.98
DA1A 28V/10.8A out 300VDC/280ma..... 14.95
150VDC/10ma, 14.5vdc/8A..... 3.98
PE94 24V Input Plate Supply..... 11.95

POTENTIOMETERS — Type J

5 ohm Type J ¼" Flatted Shaft..... 1.49
200 ohm Type J ¼" Slotted Shaft..... 1.49
500 ohm Type J ¼" Flatted Shaft..... 1.49
1000 ohm Type J ¼" Flatted Shaft..... 1.49
2500 ohm Type J ¼" Shaft 1.45
7K ohm Type J¼" Slotted Shaft..... 1.25
25K ohm Type J ¼" Slotted Shaft..... 1.25
50K ohm Type J ¼" Flatted Shaft..... 1.49
100K ohm Type J ¼" Flatted Shaft..... 1.49
1 met. Type J ¼" Slotted Shaft..... 1.25
1 meg. Type J11 (Triple) 1 ¼" Shaft..... 4.69

RHEOSTATS

Mfd.	200 WW	Each	Mfd.	1200 WW	Each
2 ohm 50W Model J		$2.29			
6 ohm 50W Model LH		1.98			
15 ohm 25W w/knob		1.98			
15 ohm 50W Model J		2.35			
20 ohm 50W Model J		2.35			
50 ohm 50W w/knob		2.35			
100 ohm 50W Model K		2.25			
200 ohm 25W Model D		1.98			
250 ohm 25W		1.98			
200 ohm 200W Model P		5.49			
350, 500, 5000 ohm Slotted shaft					

1000 ohm 25W Model J..... 2.25
7500 ohm 50W Model J..... 2.35
10000 ohm 50W Model J..... 2.89

ATTENUATORS

7470 & 1053 ohm 12 step W.W..... 1.98
DUAL 25000 ohm 20 step..... 1.98
DUAL 100,000 ohm 20 step..... 1.98
100,000 ohm 20 step 3DB/Step..... 4.98
Barometric Pot 140% ohms..... 2.89

TUBE CARTONS

STYLE	SIZE	Per/100	Per/500	Per/1000
Min	1"SQx2¼	3.5	6.10	7.75
Ler Min	1"SQx2¾	3.5	4.50	8.25
Mni G	1¼"SQx4¼	4.35	6.50	12.45
G	1¼"SQx5¾	1.00	4.85	9.45
Lge G	2"SQx5	2.49	11.95	19.95
Lge Oct	2"SQx6¼	2.95	13.50	24.95

BC618/21C Kit and Xformer 2 Tubes, Sckts, 115V/60cy Xformer..... $6.98

CONDENSERS AND COMPONENTS

2 MFD/330VAC /1KVDC Oil Cndsr 2 for .98 12 for $5.
SPRGE CRYST Vert Interpolar Netwk 3 Cndsrs, 3 Res. Only 1 LEADS 2 for $1.
DISC CERAMIC Dual .004 MFD/600V. 6 for $1.
VARIABLE 14 GG Groundinsed..... $18.95
50 PWR Magnifier & Cndsr Lenses $1.25 4 for $5.
Silver & Mica Cndsrs..... 10 for $2.50
Controls, 50 ohm to 2 meg..... 10 for 2.98
Resistors, 5 W, to 2 Megs..... 100 for 5.98
Vitreous WW Resistors..... 5 for 1.00
Sockets, Asstd. 5, 7, 9, 4P..... 25 for 2.49
Relays, Asstd. 2 to 4 PDT..... 10 for 2.98
Coil Forms, 1½ d 8m HP..... 50 for 1.00
Iron Core Stub & Screw..... 50 for 1.00
Knobs, Asstd. w/Insets..... 10 for .98
Spaghetti Sleeving, Asstd..... 25 ft 98c for 1.00
Ceramicon Cndsrs, Asstd..... 12 for 1.00
Resistors, 2 W Asstd..... 25 for 2.98
Tie-Point Lugs Asstd..... 25 for .98

OIL CAPACITORS

Mfd	Each	Mfd	Each	Mfd	Each
	1200vdc		1500vdc		10000vdc
4	.49	.05	.79	.02	1.49
	1250vdc	1	1.09		12000vdc
1-1-1-3	.49	2	1.98	.02	1.98
	1500vdc	4	2.98		15000vdc
2	.49	10	4.98	.02	15.98
2x.25	.35		1400vdc	2	20.98
	1500vdc	.25	1.29		15000vdc
1.3	.39	.5	1.39	.0015	2.50
	1600vdc		1500vdc		20000vdc
.4	.49	.5	1.89	.00025	7.49
.5	.59	1	2.79	1	25.98
.8	.79	2	3.79		AC RATED
1	.89	2	2.29		220vac/600vdc
1	1.49	3	2.29	2	.49
2	1.49	4	2.49	4	.89
6	2.29	5	2.98	5	1.29
8	2.98		1.6KV/2KVPK		220vac
10	2.89		2000vdc		330vdc
2x.1	.79	.25	.79	3.3	.79
2x.5	.98		2500vdc		330vac
2x.1	.98	1	1.49		660vdc
2x.25	.89	2x.1	1.79	1	1.39
	1800vdc	2	2.49		330vac
.024	.49	3	2.98		1000vdc
.1	.44	4	3.98	1.25	.79
.25	.75		2500vdc	1.5	.89
.5	.89	.25	2.29	1.75	.98
1	.85	.5	2.29	2	1.03
2	1.49		3000vdc	2.5	1.25
3	1.98	.1	2.49	2.5	1.35
4	2.49	.25	2.49	3	1.49
5	2.79	.5	4.49	4	1.29
6	2.98	1	5.49	4	1.49
10	3.79		4000vdc	15	3.98
2x.1	.79	2	5.98	25	6.49
2x.25	.85		7500vdc	40	9.98
2x.5	.98	.02	2.98		600vac/
2x1	1.19	.1	4.98		1200vdc
2x2	1.49		10000vdc	.15	1.29
2x4	1.49	.5	19.98		600vac/
2x.22	.98		7500vdc		1800dc
2x.22	.98	.002	1.49	16	6.98
2x.25	1.00	.0075	1.98		2000vac
	750vdc	.1	4.98	8	4.49
4	1.98		7500vdc	6	4.98
	2000vdc	.02	2.98	10	6.98
1	.69	.05	3.49	16	7.98

HIGH CURRENT MICA CNDRS

CYLINDRICAL SIMILAR TYPE "G"

MFD	KV	AMPS	MC	EACH
.02	1.5	25	1	$14.98
2X.002	1.5	7	1	2.98
.0002	6	5	1	3.98
.01	10	30	1	49.50
.00005	20	4.5	3	4.98
.0004	20	22	3	45.00
.0025	20	12	3	45.00
.005	15	30	3	45.00
.0025	13	20	3	28.95
.0015	6	8.5	3	5.98
.001	30	30	3	150.00
.0005	35	13	3	39.95

Brand NEW Made to Rigid Gov't Specs.

MICA CAPACITORS

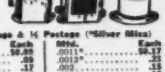


Fig. A. Postage & ½ Postage ("Silver Mica")

Mfd.	Each	Mfd.	Each
.00003	$0.89	.0011*	$0.17
.000022	.89	.0012*	.15
.000024	.89	.0015*	.15
.000025*	.17	.0022*	.15
.00003*	.89	.003/.015*	.15
.00004*	.17	.0033*	.15
.000082	.89	.004	.27
.0001	.89	.0043*	.42
.0003	.89	.005	.15
.0005	.89	.006	.15
.0007	.89	.007	.15
.0008	.89	.00015	.98

Fig. B. .001 mf, 10c; .006 mf, 23c; .01 mfd, 35c.
Fig. C. Solder Lug Terms & Mtg Holes

Mfd.	Each	Mfd.	Each
500 WV		300 WV	
.0001	$0.29	.02	$0.70
.001	.42	.05	1.19
.003	.48	1200 WV	
.004	.53	.002	.46
.005	.53	.004	.46
.006	.53	.005	.79
.008	.53	.01	.79
.01	.56	2000 WV	
		.00047	.89

Fig. D. Screw Term & Mtg

Mfd.	600 WV	Each	Mfd.	1200 WV	Each
.0001	$0.29	.01	$0.78		
.00055	.37	.013	.89		
.001	.37	.02	.89		
.0012	.44	.033	2.98		
.0015	.44	2000 WV			
.002	.54	.0004	.89		
.005	.71	.003	.89		
.01	1.19	.0025	.89		
.02	1.19	.0024	1.19		
.03	1.19	.0033	1.49		
.039	1.98	.0035	1.19		
.04	1.98	.0045	1.49		
.05	2.79	.005	1.49		
1200 WV		.0055	1.49		
.001	.61	.01	1.98		
.002	.61	.018	2.19		
.003	.71	3000 WV			
.0065	.78	.005	1.49		

Fig. E. Upright Knobs Micas

Mfd.	250 VDC	Each	Mfd.	Each
.05		$0.47	.0001	1.98
.2		2.89	.0005	1.98
	1500 VDC		.0007	1.19
.04		.89	.0055	1.19
.05		1.49		3000 VDC
	2000 VDC		.0055	1.35
.003		1.98	.008	1.79
.005		1.98		5000 VDC
.006		1.25	.0003	.79
.01		1.25		6000 VDC
.015		1.98	.00082	1.65
.02		1.98	.0011	1.79
.03		2.35	.0015	2.79
	2500 VDC		.00175	2.79
.005		1.98	.0025	2.85
.008		1.03	.0043	2.85
	3000 VDC		.0050	1.99
.0005		.79	.01	4.79

Fig. F. Heavy Duty, Upright, Skite Cnd.

Mfd.	Kv.	Each	Mfd.	Kv.	Each
.003	5	$4.89	.01	5	$10.98
.0002	5	4.89	.0002	8	7.98

866A KIT AND XFORMER

2 Tubes, Sckts, amfr 115v 60cyc Input, output 2.5vct, 10A/10kvdc..... $6.98

DIODE PROBE TUBE

Unscelled for **No-Loss V99** testing. Ultra-sensitive subminiature envelope. App. 1x¼"Dy. Element and probe at tip. Low per. htr. **Brand New**, w/data **VR92 2Sc**..... 5 for $5.

TRANSFORMERS

115 V 60 Cyc Input

TV & CRT Type Xfmr for 7" to 20" Tubes. Hi VOLTS to 20 KV (w/ quadrupler ckt). ALL Tubes, Pt. & Fil. wdgs Hivolt 800 VDC/ 275Ma Full-Wave. 6.4V/10.5A, 5.4V/8A, 2.5V/3A Hivolt Cent. Off isuprg.....$7.98
2500V Pr CRT 0.

Infrared Snooperscope
Image-Converter Tube. Hiltenativity simplified design 2" dia. Willemite screen — Resolution up to 350 lines/in. Complete data & tube, each $4.50; 2 for $9.45

BLOWERS

40 CFM 28 vacdc	$5.98
250 CFM 28 vacdc	$11.95
200 CFM with 26 to 115 vac Trans.	$1.95
175 CFM 220 vac	$1.95
40 CFM 24 vdc BL1000	$6.98

SOLDERING LUGS

TYPE	LGTH	HOLE	PER 1000
A	3/8	6	$2.98
B	½	5/16	3.98
C	¾	8	2.98
D	10/16	6	2.98
E	¾	10	3.98
C	13/16	10	2.98
D	9/16	Rivet	2.98
E	¾	4	2.98
I	5/16	6/16	2.98
F	14/16	10	1.98
G	10/16	4	2.98
G	14/16	8	3.98

MFGS. TELL US YOUR HARDWARE NEEDS
SNAKEPROOF SOLDER LUGS

C	¾	4	500 for $3.44
C	¾	10	500 for 3.98
DUAL	1¾	8	500 for 8.75

Assortment of 60 for 98c

EYELETS

LGTH.	DIA.	PER 1000
3/16	¼	$2.98
¼	5/32	4.98
⅜	5/32	5.98
⅜	9/32	7.95

CIRCUIT BREAKERS

Heinman Mom Brks, **Amps:** 0.25, 2, 3, 5, 7, 9, 12, 14, 20, 30, 35, 40, 50, 100. Each $1.69, 10 for $15.98
No. D & CH Toggle for Brkrs, **Amps:** 5, 10, 15, 20, 25 Each 98c ..... 10 for $8.98
Klixon Thermal Push Button Brkrs **Amps:** 5, 10, 15, 20, 30, 50 Each 89c ..... 10 for $7.98

"WILLIAMSON" 10W HI-FI KIT

20 to 20000 cycles with Ease! Internationally Famous: For HiFi enthusiasts. Incl Pwr supply, selected parts: Balanced resistors $29.50
W'mson PreAmp Kit & Tone boost Assmblies, chassis, parts, pwr supply $34.50
SUPER-WIDE-RANGE HiFi TRIODE 10W KIT. 10 to 20000 cycles, 6SJ4(3's, Max Harmonic Distortion 1¼% at full output & only ¼% at 4W output. Includes Bass & Treble tube boost & Tone etc 4PreAmp G.E. pickup & dual & 2 output (7) tubes, Parts, RCA chassis & info., less output xformer $29.95
UTC Hi-Fi Output Xfrm for P.P. 2A3, 6B4, 6A5 & 61A Cnf cap 30 W; Sec 5 taps 2¼ to 250 ohms $6.00
GE Dual Reluc Cartridge RPX 050 ..... $7.29
GE Reluc Cartridge RPX049 or 041 ..... $7.29
GE 512S1D Hi-Fi 12" PM Spkr $18.98
Sensational 10" HiFi/Spkr Ideal 10 Watt Home Use, Concentric, Separate Driver Woofer & Horn **Driver Tweeter—30 to 16000 cps Range English rotsp $18.98**
Electro Voice EV16M dual twilt Cart. $3.98
Hi Gain Dynamic Mike & Xfrm $1.98
XFMR HM-8LD UTC/Super Elect 3 wdg. 600 ⇔ ct & 4000 tapped 250 & 150 ⇔ can be used Mike to Grid, Line to Grid & Line to Line. Cnd & Hmt Std **SPECIAL** 40 Ten for 4.49 ..... 100 for $37.50

CRYSTALS AND SOCKETS

MTD. FT243 S.C. SPECS: 2525, 3055, 3700, 3732, 3925, 3980, 5000 KC **$1.98** ..... 4 for 4.75
Write for other Frequencies.
Mtc Cross Xtals—Hilacey Stability 5010, 5025, 5055Kc, ea. $14.98
Rochelle Salt Xtals, 69c; 10 for $5.98
Mi. Freq. Dual 2 Pin Socket 50c; 12 for $1.98
MF Xtal Holder ½" Spacing ½" Fins, 12 for $1.98
Johnson Miracles 3 Pin Socket 35c

Selenium Power Supply
0 to 12VDC/3 Amp. Variable DC supply, cased and completely built — input 115v/60 cy. Usable LAB supply, filament D.C. plating, battery charging, model railroad, insulin voltage or speed control and center off reversing sw. Ideal for two "HO" locomotives $10.98
2 for $20.00

SOLDERING IRON GUN

SENSATIONAL VALUE, lightweight heavy duty soldering gun, with removable alloy tip—will not corrode. Tip is flat, can be used for soldering large and small parts "TAB Special $2.98

PARTS CABINET

50 Draw Hvy. Steel 34¼"H/18"W/9"L/88 lbs. Draws 3"W/2¼"H/8"L ..... @ $34.
100 Draws as above ..... @ $43.
27 Draw Hvy. Steel 37"H/30¾"W/14¼"L/125 lbs. Draws 2"H/9"W/12"L ..... @ $39.98
Write for Quantity Price "EXTEND BO"

METER SPECIALS

1000 Tuning Mtr GE pnl dia. $1.29

DC MICROAMMETERS

0-20 mu Weston 2" sq. $6.98
0-500 ua. 2¾" Dia. 6.98

DC MILLIAMETERS

0-1 Ma 3" sq. Weston 7.98
0-10 Ma A-S-18V (Basic 1 Ma), 2½" 4.98
0-10 Ma A-S-18W (Basic 1 Ma), 2½" 4.98
0-25 Ma, Weston 3" sq. 4.98
0-50 Ma, Weston 3" sq. 5.98

DC AMMETERS

0-1A, 2½ Weights 4.98
0-5A, 2½ Triplett 3.49
0-10A, 2½ sq Triplett 3.98
0-15A, 2½" Triplett 3.98
0-30A, 2½" Shunt WECo, Weighs 2.98
0-50A, 2½" Int. Shunt, WECo 2.98
0-300A, 2½" Less Shunt 3.98
0-300A, 3" Less Shunt, WECo 4.49

RF METERS

0-1A, 2½" G-E, USN—R Cal 3.98
0-1A Rectifron 2½" Round 3.98
0-1A Weights 2½" Rnd 1.79
0-1A, 2½" Triplett Hi-Freq.; Int. Couple 4.98
0-3A, 2½" Weights USN 2.49
0-1200MA Weston 301 2½" 14.98

NEW THRIFT-LITE LIFETIME PHOTO-FLASH

Not a kit. Incl Per prk. Lite std Lamp, Rflctr & 15'cord 1/1000 fse flash every 7 sec. Trns day lite color. Usable all cameras opw 115VAC w/lite Trns AC40 ..... $41.50
Complete Outfit for AC & Battery ope. Incl AC40&BP24 w/speak & all sconce for KODAK & COMPUR shutters $8.98
Write for Complete "THRIFTLITE" Data. Bonnie-packs. Ext Cords. Units for Fuel, plane shutters & accessories. WE BUY, SELL & SWAP.

TAB "SUN-FLASH" LAMPS

"Tab" No.	Replaces	Each	W-Sec. 1000
U10	Ge FT114	19¢	$ 5.98
No. 1	SYLVO-LUX 1004X	25¢	10.98
22GT	GE PT 210	25¢	10.98
25GT	GE PT420	25¢	10.98
VA	SYLV. 4338	25¢	11.98
23MT	PT214	25¢	10.98
22GT	PT116	25¢	10.98
25GTQ	PT403	25¢	10.98

R1349 FLASH TUBE — Nationally advtd. $35.00
X-400 Air Corps Lamp 14.98

U-4/GT CONNECTORS

Used as switchboard for cables, general Audio and Telephone circuits, EES or any 5-party line. Indenting lamp registers. Space for line number

excellent HF/RF indicator. Each 29c ..... 4 for 98c ..... 50 for $10.00

SOUND-POWERED Head & Chest Sets

Complete Navy Unit—Cushioned Headsets, Chest Box, Mike, Cable & Wrl Plug. Adjustable Units. Tested Used, Exc. Cond. Each Unit **$6.45. Pair** $9.98
RCA MI-34848 Head & Chest Set Sound Powered $12.98
Brand New $12.98
P-38 Revrs w/Hand & Cord 36K83 ..... $4.98
HS-18-A Revrs/Cord w/PL54 less/BD Hood $2.98
SPECIAL Ea. 98c; 12 for $10.00
Ball Pans Gld Red or Blue ..... 8 for $1.00
Ball Pans Drk Ironman Blue ..... 8 for $1.00

TUBES

"TAB" TESTED & GUARANTEED
PRICES SUBJECT TO CHANGE

Use Your Priority for SPEEDY DELIVERY—Extend Your DO & Confirm! Not

Top Dollar Paid for Your Surplus Tubes—Send List and Prices

THAT'S A BUY "TAB" THAT'S A BUY
DEPT. 3E SIX CHURCH ST. NEW YORK 6, N.Y. U.S.A. CORNER CHURCH & LIBERTY STS. ROOM 200

INDEX TO ADVERTISERS

Ace Engineering & Machine Co., Inc. 210
Acme Electric Corp. 391
Acme Electronics, Inc. 423
Advertising Council 303, 329
Aeronautical Communications Equipment, Inc. 422
Aerovox Corporation 53
Aircraft Radio Corporation 362
Airdesign, Inc. 342
Airflyte Electronics Company 417
Air Marine Motors Inc. 397
Airpax Products Company 25
Alden Products Co. 71
Allen-Bradley Co. 95
Allen Co., Inc., L. B. 429
Allen Manufacturing Company 310
Allied Control Company, Inc. 78
Allied Radio Corp. 345
Alimetal Screw Products Company, Inc. 387
Altec Lansing Corporation 347
American Chronoscope Corporation 416
American Electric Motors 302
American Gas Accumulator Company 350
American Lava Corp. 240
American Phenolic Corporation 158
American Relay & Controls, Inc. 348
American Smelting & Refining Company, Federated Metals Div. 253
American Television & Radio Co. 418
American Time Products, Inc. 200
Amperite Co., Inc. 320
Ampex Electric Corporation 230
Anchor Metal Company 417
Andrew Corporation 238
Antara Chemicals, Div. of General Dyestuff Corp. 54, 55
Anton Electronic Laboratories, Inc. 36
Arma Corporation 34
Arnold Engineering Co. 188
Arrow Electronics Inc. 51
Art Wire & Stamping Company 387
Astron Corporation 355
Atlas Metal Stamping Company 233
Audio & Video Products Corp. 323
Audio Devices Inc. 317

Ballantine Laboratories, Inc. 166
Bardwell & McAlister 306
Barker & Williamson, Inc. 358
Barry Corporation 15
Beam Instruments Corporation 254
Beaver Gear Works, Inc. 360
Belden Manufacturing Co. 265
Bell Aircraft Corporation 338, 417
Bell Telephone Laboratories 263
Bendix Aviation Corporation
Eclipse-Pioneer Division 378
Red Bank Div. 215
Bentley, Harris Manufacturing Co. 64
Berkeley Assoc., Edmund D. 429
Berkeley Scientific Corporation 284
Bird & Co., Inc., Richard H. 258
Bird Electronic Corp. 410
Birnbach Radio Co., Inc. 401
Birtcher Corporation 286
Biwax Corporation 370
Bliley Electric Company 298
Bodnar Industries, Inc. 417
Boeing Airplane Company 379
Bogart Manufacturing Corp. 406
Bogue Electric Mfg. Co. 196
Boonton Radio Corporation 153
Borg Corporation, George W. 412, 413
Bowser, Inc. 373
Breeze Corporations, Inc. 161
Bridgeport Brass Co. 176
British Electronic Group 273
Browning Laboratories, Inc. 222
Brubaker Mfg. Co. 429
Buck Engineering Co., Inc. 400
Burgess Battery Company 322
Burlington Instrument Co. 340
Burnell and Company 75

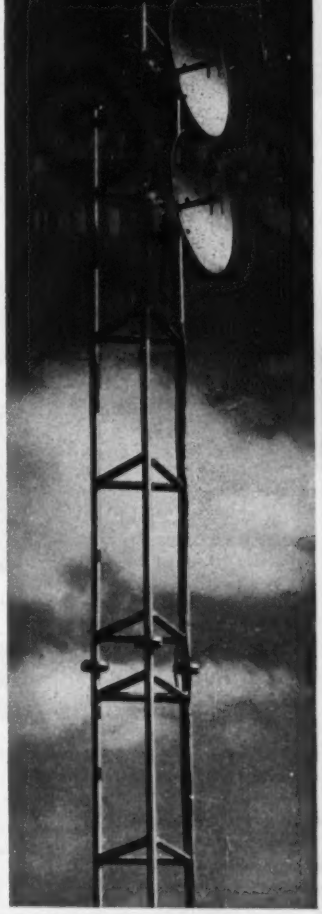
Burstein-Applebee Co. 413
Busemann Mfg. Co. 65

C & G Mfg. Sales Co. 429
C.G.S. Laboratories, Inc. 361
Caldyne Company 287
Cambridge Thermionic Corp. 46
Cannon Electric Co. 304
Carter Motor Co. 355
Centralab, Div. Globe-Union, Inc. ..11, 12, 13
Chase Brass & Copper,
Sub. of Kennecott Copper Corp. 375
Chatham Electronics, Inc. 36, 27
Chester Cable Corp. 182
Chicago Condenser Corporation 375
Chicago Telephone Supply Corp. 65, 69
Chicago Transformer, Div. of
Essex Wire Corp. 362
Ciba Company, Inc., Plastics Div. 173
Cinch Manufacturing Corp. 149
Clarostat Mfg. Co., Inc. 48
Cleveland Container Company 63
Clippard Instrument Laboratory, Inc. 292
Cohn Corporation, Sigmund 202
Coil Winding Equipment Co. 426
Cole Steel Equipment Co. 58
Communication Accessories Company 288
Communication Measurements
Laboratory, Inc. 399
Compagnie Generale de T.S.F. 93
Condenser Products Company 35, 321
Continental-Diamond Fibre Company 155
Cornell-Dubilier Electric Corp. 171
Cornish Wire Co., Inc. 371
Corry-Jamestown Mfg. Corp. 218
Coto-Coil Co., Inc. 397
Crescent Company, Inc. 320
Crest Laboratories, Inc. 377
Crosby Laboratories, Inc. 420
Cross Co., H. 423
Crucible Steel Company of America 197

Daniels Inc., C. B. 397
Dano Electric Company 419
Daven Co. ..... Third Cover
DeJur Amsco Corp. 472
Dial Light Company of America 421
Distillation Products Industries 175
Doelcam Corporation 312
Dolin Metal Products, Inc. 423
Dow Corning Corporation 278
Driver Company, Wilbur B. 293
Driver-Harris Company 181
DuMont Laboratories, Inc., Allen B. 37, 67, 220, 393
du Pont de Nemours & Co., (Inc.), E. I. .. 235
Duro Specialty Company, Inc. 62
DX Radio Products Co. 350

Eastern Air Devices, Inc. 346
Eastman Kodak Company,
Industrial Optical Sales Div. 159
Edin Company, Inc. 351
Edison, Incorporated, Thomas A. 354
Edo Corporation 255
Eicor, Inc. 60
Eisler Engineering Company, Inc. ..338, 429
Eitel-McCullough, Inc. 40
Electrical Industries, Inc. 83
El-Tronics, Inc. 429
Electro Impulse Laboratory 368
Electro Tec Corporation 201
Electro-Tech Equipment Co. 393
Electro-Technical Products,
Div. of Sun Chemical Corp. 196

"SPECIFY
Towers by Stainless"



Stainless Towers offer you:

- All welded, tubular steel construction
- Easy-to-erect 20-ft. sections
- Aerodynamic design providing minimum wind resistance
- Natural ladder — easy to climb easy to maintain — IMMEDIATE DELIVERY

STAINLESS, INC.
NORTH WALES, PA.
PHONE: NORTH WALES 874

Announcing THE NEW C-200

DeJUR External Phasing Potentiometer

The new C-200 high precision potentiometer has been engineered and designed by DeJur-Amsco to fulfill the exacting requirements of contemporary instrument, computer and similar electronic equipment.

Designers are invited to submit their applications to DeJur engineers for recommendations and suggestions.

- 2" Diameter
- 4 Watts Fully Enclosed
- 10 to 200,000 Ohms Accuracy up to 1%
- Linearity up to 0.3%
- Non Linear Windings
- 360° (Continuous) Mechanical Rotation
- 320° Electrical Rotation
- Taps as Required
- High Resolution 1,000,000 Cycles Operational Life
- Precious Metal Contacts
- Low Torque 1 oz. inch
- Centerless Ground Stainless Steel Shafts
- Ball Bearings to Special Order
- Single or Ganged Units
- Servo Type Mounting or Single Hole Threaded Bushing
- Numerous Shaft Designs

WRITE FOR BULLETIN 100-E

DeJUR AMSCO CORPORATION
45-01 NORTHERN BOULEVARD, L. I. C. 1, N. Y.
MANUFACTURERS OF SCIENTIFIC PRECISION EQUIPMENT FOR OVER A QUARTER OF A CENTURY
• CAMERAS • PROJECTORS • ENLARGERS • EXPOSURE METERS •

Electronic Associates Incorporated 394
Electronic Measurements Co. 414
Electronic Transformer Co., Inc. 385
Ellis Jr., Harold R. 273
Elveco Parts 92
Empire Devices, Inc. 401
Engineering Co. 423
Erie Resistor Corporation 41

Fairchild Camera & Instrument Corp. 134
Federal Telephone & Radio Corporation 40, 333
Federated Purchaser Inc. 345
Federation Francaise Des Syndicats Nationaux De L'Industrie Radioelectrique 89
Ferranti Electric, Inc. 177
Ferroxcube Corporation of America 219
Fidelity Chemical Products Corp. 310
Filtron Co., Inc., The 43
Foote Mineral Company 300
Ford Instrument Company 324
Frequency Standards Corporation 411
Furst Electronics 474

Gamewell Company 422
General Ceramics & Steatite Corp. 229
General Electric Co.
Apparatus Dept. 70, 80, 81, 251, 298, 383, 390
Carboloy Dept. 76, 77
Electronics Dept. 47, 57
General Precision Laboratory, Inc. 217
General Radio Company 17
General Transformer Company 322
Giannini & Co., Inc., G. M. 398
GM Laboratories, Inc. 403
Gombos Co., Inc., John 359
Grant Pulley & Hardware Co. 257
Graphite Metallizing Corp. 266
Gray Research & Development Co., Inc. 232
Green Instrument Co. 338
Gries Reproducer Co. 429
Griffin Company, John 421
Guardian Electric Mfg. Co. 260
Guthman Co., Inc., E. I. 260

Harnett Electric Corporation 316
Harrison Radio Corporation 331
Hathaway Instrument Co. 278
Haydon Company, A. W. 393
Haydon Manufacturing Co., Inc. 326
Heath Company 164
Heiland Research Corporation 400
Heinemann Electric Company 345
Heldor Bushing & Terminal Co., Inc. 74
Helipot Corporation 203
Heminway & Bartlett Mfg. Co. 363
Hermetic Seal Products Co. 70
Hewlett-Packard Company 28, 29
Hexacon Electric Co. 425
Heyman Manufacturing Co. 474
Hillburn Electronic Products 413
Hi-Q Division of Aerovox Corp. 165
Holtzer-Cabot Division of National Pneumatic Co., Inc. 199
Hudson Radio & Television Corp. 338
Hudson Wire Company 241
Hughes Research & Development Laboratories 375
Hytron Radio & Electronics Co. 227

Improved Seamless Wire Company 344
Industrial Condenser Corp. 425
Industrial Hardware Mfg. Co., Inc. 389
Industrial Rectifier Corp. 430
Industrial Tape Corp. 349
Institute of Radio Engineers 353
Instrument Corporation of America 187
Instrument Resistors Company 404, 405
Instrument Specialties Corporation 270
International Nickel Company, Inc. 277

International Pump & Machine Works.. 407
International Rectifier Corp..... 172
Irvington Varnish & Insulator Company. 23, 309

Jeffers Electronics, Inc..... 307
Jelliff Mfg. Corp., C. O..... 342
Jennings Radio Manufacturing Co..... 356
Johnson Co., E. F..... 19
Jones Div., Howard B., Cinch Mfg. Corp. 342
Joy Manufacturing Company..... 24

Kahle Engineering Co..... 335
Karp Metal Products Co., Inc..... 85
Kartron, Inc. 429
Kay Electric Company..... 301
Kellogg Company, M. W. Chemical Mfg. Division 319
Kenyon Transformer Company, Inc..... 163
Kepco Laboratories, Inc..... 297
Kester Solder Company..... 245
Keystone Products Co..... 224
Kings Electronics Co., Inc..... 283
Kinsby Manufacturing Co..... 167
Kirk & Blum Mfg. Co..... 274
Klein & Sons, Mathias..... 190
Knights Co., The James..... 234
Kollsman Instrument Corp..... 180
Kotron Rectifier Corp..... 279
Krohn-Hite Instrument Co..... 206

Laboratory for Electronics, Inc..... 235
Lambda Electronics Corporation..... 424
Lampkin Laboratories, Inc..... 429
Landis & Gyr, Inc..... 411
LaPointe-Plascomold Corp. (Vee-D-X).. 357, 389
Lapp Insulator Co., Inc..... 257
Lavoie Laboratories, Inc..... 195
Le Materiel Telephonique..... 94
Leeds & Northrup Co..... 212
Lenkurt Electric Sales Company..... 296
Lesa 310
Lettine Radio Mfg. Co..... 411
Lewis Engineering Co..... 375
Lewis & Kaufman, Inc..... 183
Lewis Spring & Manufacturing Co..... 250
Linde Air Products Co., A Division of Union Carbide & Carbon Corp..... 286
Littelfuse, Inc. 396
Little, Inc., Arthur D..... 334
Lord Manufacturing Company..... 366

Machlett Laboratories, Inc..... 240
Magnatran Incorporated 293
Magnetic Amplifiers, Inc..... 415
Mallory and Company, Inc., P. R.....96, 151
Marconi Instruments 379
Marion Electrical Instrument Co..... 2
Markem Machine Company..... 312
MB Manufacturing Company, Inc..... 228
McGraw-Hill Book Co..274, 328, 340, 352, 363
McIntosh Laboratory, Inc..... 371
Measurements Corporation 186
Mepco, Inc. 56
Metal Hydrides Inc..... 254
Metal Textile Corporation 410
Metals & Control Corp., General Plate Div. 215
Methode Manufacturing Corp..... 360
Mica Insulator Company..... 305
Michel Manufacturing Co..... 429
Mico Instrument Co.....421, 429
Micro Switch, Div. of Minneapolis-Honeywell Regulator Co..... 231
Mid-West Coil & Transformer Co..... 302
Miles Reproducer Co., Inc..... 429
Millen Mfg. Co., Inc., James..... 264
Milo Radio & Electronics Corp..... 314

High Performance

TUBE SOCKETS

Ideal wherever high or low ambient temperatures or frequency stability are problems.

- Surface resistivity 3.5 x 10^{13} ohms.
- Loss factor less than 0.0005.
- Dielectric constant 2.0 (60 cycles to 30,000 megacycles).
- Serviceable at −150°F to +575°F with negligible change in critical electrical characteristics.
- Won't carbonize under arcing.
- 0.0% water absorption (ASTM Test).
- Unaffected by extreme humidity, corrosive atmosphere or fungus. Non-flammable.
- Chemically inert—unaffected by oils, organic or inorganic acid, alkali or solvent.
- Allocation limits supply to projects with National Production Authority sanction.
- Write for catalog No. SO-428-9.

UNITED STATES GASKET COMPANY

TEFLON PRODUCTS DIVISION

600 N. 10TH STREET, CAMDEN, N.J.

TWO *NEW*
TWIN POWER SUPPLIES

I.R.E. SHOW—BOOTH #363

MODEL 610-F

- Precise Electronic Regulation.
- 2 Independent Sources of Power.
- 0-325 V.D.C. at 0-100 Milliamperes. Continuously Adjustable.
- 0-325 V.D.C. at 0-200 Mils if the Sources are Combined.
- Both D.C. Outputs Metered for Voltage or Current.
- 6.3 and 12.6 V.A.C. Outputs Provided.
- A.C. Ripple Less than 10 Millivolts.

MODEL 1210

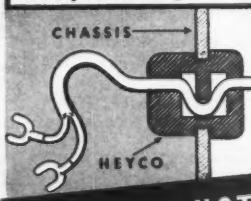
- Precise Electronic Regulation.
- 2 Independent Sources of Power.
- 0-500 V.D.C. at 0-150 Milliamperes. Continuously Adjustable.
- 0-500 V.D.C. at 0-300 Mils if the 2 Sources are Combined.
- Both D.C. Outputs Metered for Voltage or Current.
- 6.3 or 12.6 V.A.C. Outputs Provided.
- A.C. Ripple Less Than 10 Millivolts.

Also available with regulated bias output.

Furst *Twin* Power Supplies double the usefulness of a single unit at considerable saving in space and cost. Write for complete specifications on these and other Furst *Twin* Power Supply Models.

FURST ELECTRONICS
10 S. Jefferson St., Chicago 6, Ill.

Facts you should know about HEYCO STRAIN RELIEFS!
the Nylon Bushings that Anchor cord to housing



1. Absorb cord pull, push and torque
2. Insulate wire from housing

CUT PRODUCTION COSTS
IMPROVE PRODUCT QUALITY

APPROVED SA UL

SAMPLES? Send wire size and chassis information—
Try HEYCOS at no cost to you—today!
MADE IN ALL SIZES FOR CLOCK WIRE TO S-10/3 CABLE

HEYMAN MANUFACTURING COMPANY
KENILWORTH 2 NEW JERSEY

HEYCO ELIMINATES STRAIN ON TERMINALS

THE HEYMAN ORGANIZATION WITH 25 YEARS STAMPING EXPERIENCE HAS MODERN PRESS CAPACITY FOR OVER 2,000,000 FINISHED STAMPINGS PER DAY.
ASK FOR BULLETIN 33

Minneapolis-Honeywell Regulator Co., Industrial Division 21
Minnesota Mining & Mfg. Co. 170
Mitchell-Rand Insulation Co., Inc. 193
Modulation Products Co. 420
Moninee Paper Mills Company 282
Muirhead & Co., Ltd. 3
Mullard Overseas Ltd. 370
Multi-Metal Co. 324
Murray Manufacturing Corporation 280
Mycalex Corporation of America 98

National Company, Inc. 336, 337
National Moldite Company 392
National Union Radio Corp. 271
National Varnished Products Corp. 230
National Vulcanized Fibre Co. 61
Neo-Sil Corporation 42
New Hampshire Ball Bearings, Inc. 381
New Hermes, Inc. 419
New York Transformer Co., Inc. 262
Ney Company, J. M. 426
Niagara Radio Supply Corp. 407
North American Aviation, Inc. 283, 371
Northern Radio Co., Inc. 45
Nothelfer Winding Laboratories 412
Nuclear Research Corporation 352
Nucleonics 373

Ohmite Manufacturing Co. 32A, 32B
Olympic Metal Products Co. 415
Opad-Green Company 342
Optical Film Engineering Co. 389

Panoramic Radio Products, Inc. 313
Peerless Electrical Products, Div. of Altec Lansing Corp. 416
Pennsylvania Testing Laboratory 407
Phalo Plastics Corp. 395
Phaostron Company 367
Pickering & Co., Inc. 397
Pix Manufacturing Co., Inc. 421
Plaskon Div. of Libbey-Owens-Ford Glass Co. 207
Plastold Corporation 33
Polarad Electronics Corp. 247
Polyphase Instrument Company 348
Polytechnic Research & Development Co., Inc. 360
Potter Instrument Co., Inc. 388
Precision Apparatus Co., Inc. 476
Precision Paper Tube Co. 408
Premax Products, Div. Chisholm-Ryder Co., Inc. 403
Premier Metal Products Co. 475
Production Tool & Fixture Co. 350
Progressive Manufacturing Company 268

Radiac S. A. 93
Radio Corp. of America ..... 157, Fourth Cover
Radio Materials Corporation 44
Radio Receptor Company, Inc. 160
Radio Shack Corporation 372
Radio Wire Television Incorporated 270
Rahm Instruments, Inc. 424
Railway Express Agency, Air Express Division 291
Raytheon Manufacturing Co. 259, 315, 330
Remler Company, Ltd. 408
Republic Foil & Metal Mills Inc. 339
Resistance Products Co. 414
Revere Copper & Brass, Inc. 32
Rex Corporation 250
Ribet-DesJardins 91
Robinson Aviation, Inc. 330
Robinson Inc., Edward E. 391
Rome Cable Corporation 353
Runzel Cord & Wire Co. 381

Sanborn Company 361
Sangamo Electric Company 84
Sarkes Tarzian, Inc. 328
Scientific Electric Div. of "S" Corrugated Quenched Gap Co. 350
Scintilla Magneto Division of Bendix Aviation Corp. 185
Sealtron Company 72, 73
Secon Metals Corporation 381
Servo Corporation of America 381, 420
Servomechanisms, Inc. 318
Servo-Tek Products Co. 206
Sessions Clock Company, Timer Div. 162
Shakeproof, Inc. 223
Shallcross Manufacturing Co. 178
Signal Engineering & Mfg. Co. 340
Siemar 90
Simpson Electric Co. 191
Smuckler & Co., Inc., A. F. 365
Societe Francaise Radioelectrique 92
Societe Omega 90
Society of the Plastics Industry, Inc. 290
Sorensen & Company, Inc. 59
Southwestern Industrial Electronics Company 174
Specialty Battery Company 403
Sperry Gyroscope Co. 205
Sprague Electric Company 9, 53
Stackpole Carbon Co. 211
Stahl, Inc., Michael 370
Stainless, Inc. 471
Standard Cabinet Company 344
Standard Electric Time Company 267
Standard Piezo Company 400
Staver Company, Incorporated 341
Steiner-Ives Company 402
Stevens Manufacturing Company, Inc. 276
Stoddart Aircraft Radio Co. 258
Struthers-Dunn, Inc. 280
Stupakoff Ceramics & Mfg. Company 261
Sturtevant Co., P. A. 348
Superior Electric Co. 327
Superior Tube Company 235
Surprenant Manufacturing Company 66
Sylvania Electric Products, Inc. 7, 169
Syntron Co. 413

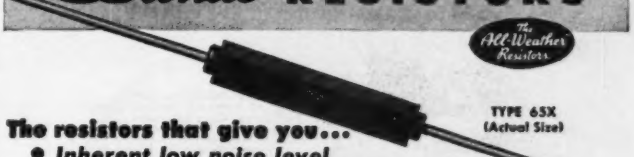
Taylor Fibre Co. 179
Taylor Tubes, Inc. 194
Tech Laboratories 387
Technical Service Corporation 421
Technology Instrument Corp. 364
Tektronix, Inc. 252
Tel-Instrument Company, Inc. 368
Telechron Department-General Electric Company 208
Teletronics Laboratory, Inc. 408, 429
Tensolite Insulated Wire Company 374
Terpening Company, L. H. 294
Thompson Products, Inc. 39
Tinnerman Products, Inc. 50
Titeflex, Inc. 262
Tobe Deutschmann Corporation 290
Trad Television Corp. 386
Transicoil Corporation 369
Transradio, Ltd. 298
Triad Transformer Mfg. Co. 306
Triplett Electrical Instrument Co. 236
Tru-Ohm Products, Division of Model Engineering & Mfg., Inc. 221
Tung-Sol Electric, Inc. 64A, 64B
Turner Co. 226

Ucinite Company 52
Ulanet Company, George 428
Union Carbide & Carbon Corp., Linde Air Products Div. 286
United Condenser Corp. 417
United Electronics 237
United States Gasket Company 473
United States Radium Corp. 242
United States Testing Company, Inc. 324
United Transformer Co. ..... Second Cover
Universal Winding Company 204

Varflex Corporation 216
Varian Associates 281

S.S.White MOLDED RESISTORS

The All-Weather Resistors



TYPE 65X (Actual Size)

The resistors that give you...

- *Inherent low noise level*
- *Good stability in all climates*

STANDARD RANGE

1,000 OHMS TO 9 MEGOHMS

These resistors are used extensively in commercial equipment, including radio, telephone, telegraph, sound pictures, television, etc. They are also used in a variety of U.S. Navy equipment.

HIGH VALUE RANGE

10 TO 10,000,000 MEGOHMS

This unusual range of high value resistors has been developed to meet the needs of scientific and industrial control, measuring and laboratory devices — and of high voltage applications.

SEND FOR BULLETIN 4906

It gives details of Standard and High Value Resistors, including construction, characteristics, dimensions, etc. Also described are S.S. White 80X Resistors, designed for extremely high voltage equipment. Copy with Price List sent on request.

THE S.S.White DENTAL MFG. CO. — INDUSTRIAL DIVISION

Dept. R, 10 East 40th St. NEW YORK 16, N. Y.

WESTERN DISTRICT OFFICE: Times Building, Long Beach, Calif.

PREMIER

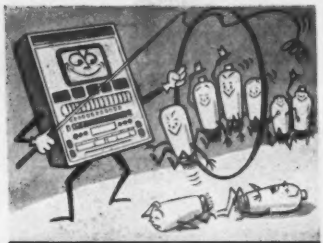
PRECISION BUILT METAL CABINETS

PREMIER METAL PRODUCTS Co.

3160 WEBSTER Ave., BRONX 67, N.Y.

"WE PREFER PREMIER!" You hear it from the experts . . . because they know that PREMIER specializes in the manufacture of standardized Racks, Cabinets, Chassis, and Panels especially for the electronic industry.

SEND FOR CATALOG



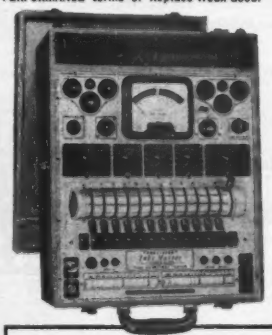
You Get OVERALL Test Performance With

—PRECISION— SERIES 10-12 *Electronamic* TUBE PERFORMANCE TESTER

with 12 ELEMENT free-point Master Lever Selector System

To test modern tubes for only one characteristic will not necessarily reveal overall performance capabilities. Tube circuits look for more than just Mutual Conductance or other single factor.

In the Precision Electronamic Circuit, the tube PERFORMS under appropriately phased and selected individual element potentials, encompassing a wide range of plate family characteristic curves. This complete Path of Operation is integrated by the indicating meter in the positive PERFORMANCE terms of Replace-Weak-Good.



MODEL 10-12-P: in sloping, portable hardwood case with tool compartment and hinged removable cover. Size 13⅜ x 17⅛ x 6⅝"..... **$101.75**
Also in counter or rack-panel mounts.

- ★ **Facilities to 12 element prongs.**
- ★ **Filament voltages from ¾ to 117 volts.**
- ★ **Tests Noval 9 pins; 5 and 7 pin acorns; double-capped H.F. amplifiers; low power transmitting tubes; etc. REGARDLESS OF FILAMENT OR ANY OTHER ELEMENT PIN POSITIONS.**
- ★ **ISOLATES EACH TUBE ELEMENT REGARDLESS OF MULTIPLE PIN POSITIONS.**
- ★ **DUAL short check sensitivity for special purpose tube selection.**
- ★ **Battery Tests under dynamic load conditions.**
- ★ **Built-in Dual-Window, brass-geared roller chart.**
- ★ **4½" Full Vision Meter.**

SEE the "Precision" Electronamic Tube Tester at leading radio equipment distributors. Write for new 1952 catalog describing Precision Test Equipment for all phases of modern electronics.

Precision Apparatus Co., Inc.
92-27 HORACE HARDING BLVD. • ELMHURST 10, N. Y.

*Reg. U.S. Patent Office

Export: 458 B'way, N.Y.C., U.S.A. Cables: MORHANEX
In Canada: Atlas Radio Corp. Ltd., Toronto, Ontario

Veeder-Root, Inc. 82
Vickers Electric Division 395
Victoreen Instrument Company 359
Victory Engineering Corporation 294
Vitramon Incorporated 389

Waldes Kohinoor, Inc. 243
Ward Leonard Electric Company 168, 169
Warren Wire Company 306
Waterman Products Co., Inc. 86, 87
Welch Scientific Company, W. M. 377
Western Gold & Platinum Works 418
Western International Company 390
Westinghouse Electric Corp. 30, 31, 192, 344
White Dental Mfg. Company, S. S. 272, 475
Whitehead Stamping Company 425
Whitney Blake Co. 332
Williams & Co., C. K. 256
Wilton Tool Mfg. Co. 346
Winchester Electronics, Inc. 248
Workshop Associates, Inc. 299, 393

Xcelite Incorporated 320

Zophar Mills, Inc. 425

PROFESSIONAL SERVICES 427

SEARCHLIGHT SECTION

(Classified Advertising)

H. E. Hilty, Manager

EMPLOYMENT

Positions Vacant 430-437
Selling Opportunities Offered 431, 436
Positions Wanted 431
Selling Opportunities Wanted 431
Employment Services 431

EQUIPMENT

(Used or Surplus New)
For Sale 438-470

WANTED

Equipment 468

ADVERTISERS INDEX

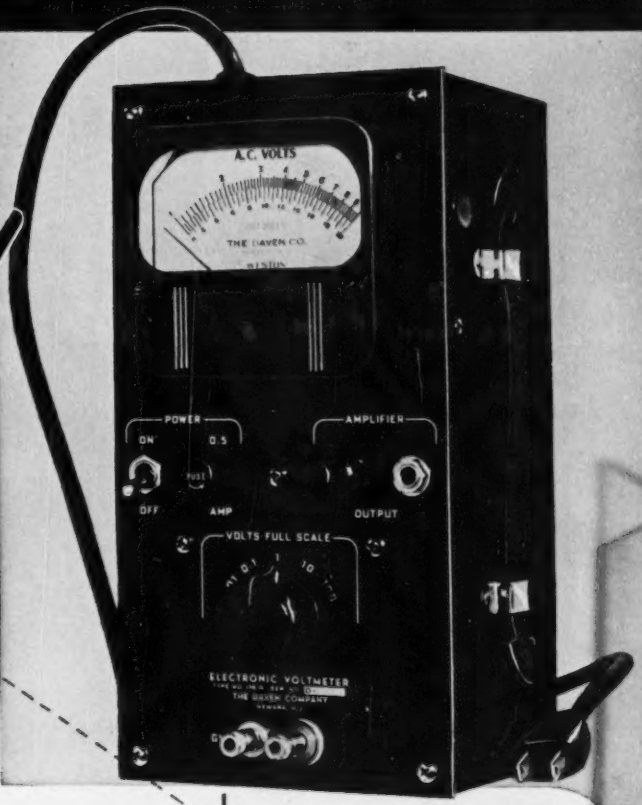
Air Transport Service 468
Allied Electronic Sales 468
Alvaradio Supply Co. 462
American Electrical Sales Co. 465
Arma Corporation 433
Arrow Sales, Inc. 462
Barry Electronics Corp. 467
Battelle Memorial Institute 437
B & B Distributors 464
Bendix Aviation Corp. 434
Bendix-Pacific 437
Berkeley Scientific Corp. 435
Blan 467
Boonton Radio Corp. 436
Brooks Inc., B. D. 465
Capehart-Farnsworth Corp. 430
Century Geophysical Corp. 436
C & H Sales Co. 437, 468
Chase Electronics Supply Co. 466
Circle Sales Corp. 460
Collins Radio Co. 436
Columbia Electronics, Ltd. 454, 468
Compass Communications Co. 461
Communication Devices Co. 466
Communications Devices Co., Inc. 465
Communications Equipment Co. 448, 449
Convair 435
Cornell-Aeronautical Laboratory, Inc. 434
Cottone & Co., A. 462
Davies Laboratories, Inc. 432
Dictograph Products Inc. 432
Edlie Electronics Inc. 455
Electro Impulse Laboratory 465
Electronic Engineering Co. of Calif. 432
Electronic Expediters 462
Electronic Specialty Supply Co. 446
Electronic Surplus Brokers 460
Electronicraft, Inc. 462
Empire Electronics Co. 461
E P C O 459
Freeland Products Co. 459
General Electric Company 427
General Motors Corp., AC Spark Plug Div. 434
G & G Radio Supply 446
G. L. Electronics 447
Goodyear Aircraft Corp. 432
Green, Gould 461
Greene, Leonard 457
Haydu Brothers 463
Houde Supply Co. 459
Instruments Associates 447
Interstate Appliance Co., Inc. 459
J.S.H. Sales Co. 460
Key Electronics Div. 464
Lapirow Bros. 465
Larkin Electronics Supply Co., Inc. 448
Lectronic Research Laboratories 438, 439
Leru Laboratories Inc. 459
Liberty Electronics, Inc. 458
Lowenthal Co., T. R. 464
Maritime International Co. 458
Maritime Switchboard 456
Matson, R. H. 466
Maxson Corp., The W. L. 434
Metropolitan Overseas Supply Corp. 461
Modulation Products Company 467
Mogull Co., Inc., Alexander 454
Monmouth Radio Laboratories 458
Norman Radio Distributors, Inc. 463
Northrop Aircraft, Inc. 434
Photocon Sales 464
Powell, Harold H. 460, 463
Precision Electrical Instrument Co. 467
Radio Development & Sales Co. 459
Radio & Electronic Surplus 457
Radio Ham Shack, Inc. 445
Radio Surplus Corp. 441
Raytheon Manufacturing Co. 437, 466
Reeves Instrument Corp. 432
Relay Sales 443
Reliance Merchandising Co. 440
Role Electronics Inc. 463
Sagal Co., Leo 465
Sandia Corp. 433
Servo-Tek Products Co., Inc. 446
Stavid Engineering Inc. 436
Sylvania Electric Products, Inc. 431
Tab 469, 470
Technical Materials Co. 465
Technical Radio Parts Co. 466
Telemarine Communications Co. 451
Terminal Radio Corp. 452
Tracerlab, Inc. 435
Universal General Corp. 444
Universal Yonkers Corp. 464
University of Minnesota 437
V & H Radio & Electronic Supply Co. 468
Weston Laboratories 455
Wilcox Electric Co. 431
Wilgreen Industries 468

This index is published as a convenience to the readers. Every care is taken to make it accurate, but ELECTRONICS assumes no responsibility for errors or omissions.

DAVEN Electronic Voltmeter

Vastly Improved

with 3 important, new features



1. Input stages of the amplifier are shock mounted to reduce microphonics.

2. The amplifier is completely shielded to prevent hum pick-up.

3. The power supply is completely shielded to prevent hum radiation in adjacent equipment.

Write for completely detailed catalog data.

THE DAVEN CO.
191 CENTRAL AVENUE
NEWARK 4, NEW JERSEY

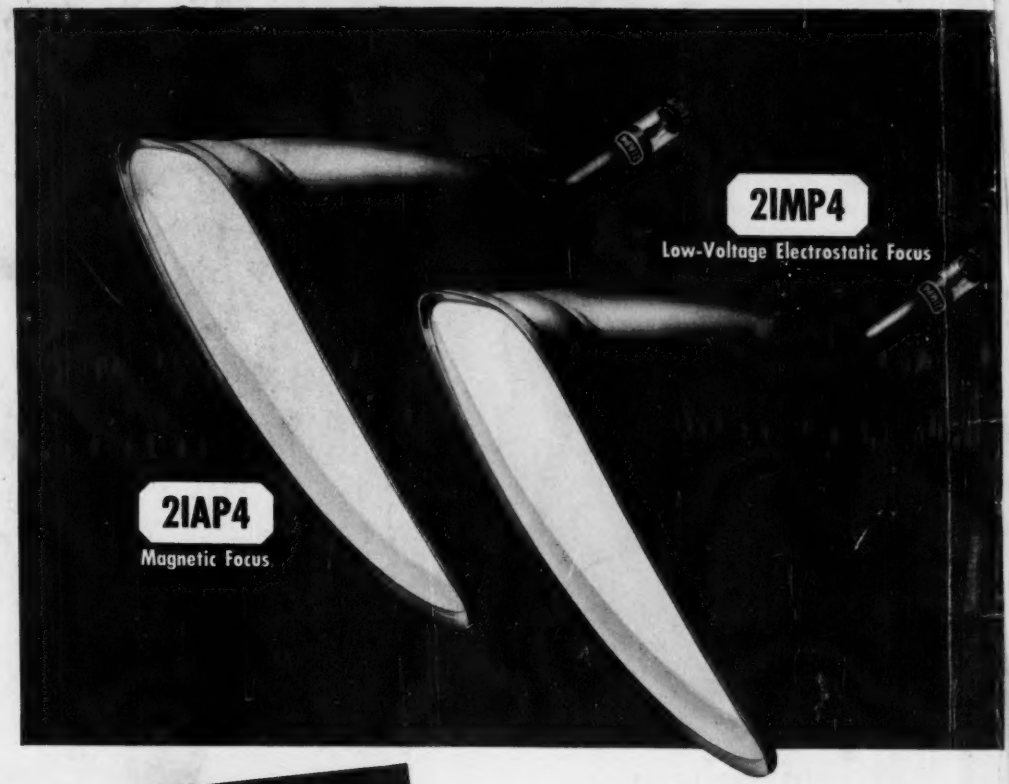
Visit Daven at the I.R.E. Show, Booths 948 & 95.

The New Daven Electronic Voltmeter, Type 170-A

is a superior, portable instrument, ideal for general laboratory and production use. It is built with typical Daven precision to measure accurately A.C. sinusoidal voltages over a frequency range from 10 to 250,000 cycles and a voltage range from .001 to 100 volts.

- Large, easy-to-read, illuminated, meter scale on which all readings may be made.
- Accuracy ± 2% over entire frequency range.
- Output jack and separate volume control for using Voltmeter as wide-range, high-gain amplifier.
- Construction permits readings independent of normal power line variations.
- Meter scale has both voltage and decibel ranges.

★ LIMITED NUMBER AVAILABLE FROM STOCK



RCA metal-shell kinescopes give you 8 plus features at no extra cost

RCA-developed metal-shell kinescopes offer design engineers, manufacturers, and users of TV receivers, many important advantages over all-glass types . . .

1 **Reflection-free Faceplates:** Frosted surface of faceplate prevents reflections of light sources and bright room objects at any angle to the tube.

2 **Superior Faceplate Quality:** Metal-shell construction permits the use of high-quality sheet glass *made to RCA specifications.* Its use results in greater freedom from imperfections, such as blisters, chill marks, shear marks, mold marks, and ripples. Faceplates of uniform thickness transmit the picture with uniform brightness levels over the entire viewing area.

3 **Less Weight:** RCA 21″ metal-shell kinescopes weigh only about 18 pounds, a value approximately 12 pounds less than comparable-size glass types. Hence, they are cheaper to ship, easier to handle during assembly and testing operations, and can be mounted with lighter supporting structures.

4 **Optically Superior:** Relatively thin and flat spherical faceplate of uniform thickness permits wide-angle viewing with minimum picture distortion.

5 **High Safety Factor:** Inherent mechanical strength of metal-shell construction provides greater factor of safety in handling operations.

6 **Utilize Time-Tested Components:** 21″ metal-shell kinescopes permit the use of proven deflection circuits and available components to produce pictures having good corner focus and negligible pin cushion. No need to experiment with special components; volume production can be achieved with minimum delay.

7 **Volume Types:** More RCA 21″ metal-shell kinescopes have been produced than the total of all 21″ glass kinescopes. Because of this production experience, 21″ metal-shell kinescopes offer a greater degree of dependability and uniformity.

8 **Availability:** Manufacturing facilities in two RCA plants insure continuous high-volume supply.

For technical data or design assistance on RCA kinescopes or other types of tubes, write RCA, Commercial Engineering, Section CR42, or contact your nearest RCA field office:—

FIELD OFFICES: (East) Humboldt 5-3900, 415 S. 5th St., Harrison, N. J. (Midwest) Whitehall 4-2900, 589 E. Illinois St., Chicago, Ill. (West) Madison 9-3671, 420 S. San Pedro St., Los Angeles, Calif.

RCA

RADIO CORPORATION of AMERICA

ELECTRON TUBES — **HARRISON, N.J.**